Electrical World

The consolidation of Electrical World and Engineer and American Electrician.

Vol. LIII. NEW YORK, THURSDAY, JANUARY 7, 1909. No. 2.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

James H. McGraw, President.
J. M. Wakeman, 1st Vice-President. A. E. Clifford, 2d Vice-President.
Curtis E. Whittlesey, Secretary and Treasurer.

239 West Thirty-ninth Street, New York.

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Chicago Office.....590 Old Colony Building
Cleveland Office.....1015 Schofield Building
Philadelphia Office.....Real Estate Trust Building
European Office....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico.....per year, $3.00
Dominion of Canada..... " " 4.50
Other Foreign Countries within the Postal Union..... " " 6.00
25 shillings. 25 marks. 31 francs.

Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to July, 1907, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Thursday of the same week.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of Electrical World *for 1908 was 898,000. Of this issue 16,000 copies are printed.*

NEW YORK, THURSDAY, JANUARY 7, 1909.

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Smaller Exports.

The world-wide diminution of commercial activity has continued to give evidence of its persistent nature in the figures of export and import trade. Quantities as well as values have suffered, and in this international exchange of commodities few signs of recovery are to be noted. The electrical exports, already shrunken far below the levels of other years, are still discouragingly small for November, and it is evident that the year will round itself out with relatively insignificant totals. The figures for November are again considerably below the level of the last two years. The exports for the month of electrical appliances and instruments were $463,588 as compared with $542,524 in 1907. The exports of heavy electrical machinery were only $295,915 as compared with $700,276 in 1907. They could hardly go much lower. The total of instruments for the 11 months was $5,045,392 as compared with $7,209,844 in 1907 and $7,553,111 in 1906; and of machinery $6,369,163 as compared with $8,897,419 in 1907 and $7,638,898 in 1906. There is evidently no possibility of closing up such gaps in a single month. The data must be viewed with fortitude, but not necessarily with resignation.

On the other hand, copper, which is now a great electrical product, seems to be going abroad in great quantities. What on earth they are doing with it would be a difficult thing to explain; they are certainly not using it, and meantime in this country a stock of over 210,000,000 lb. appears to have stacked up. The quantity sent was not great in November, the amount of pig, ingot, bars, plate, etc., being 45,439,665 lb., or about half as much as in 1907. But, on the other hand, the total for the 11 months is 613,784,924 lb. as compared with 426,671,051 in 1907, and 420,612,664 in 1906. Here is a difference of very nearly 200,000,000 lb.; and no one can be persuaded that it is being consumed abroad. No such conditions of absorption exist in any copper-using industry, but if anything the demand is below that of previous years. Some kind of mystery seems to lurk in the movement. Possibly the market here is automatically relieving itself of big domestic accumulations. But it does look as though there was a terrible lot of copper piling up awaiting someone's buying and the return of good times. Electrical consumers can well afford to exercise patience and should look for a lower market if production is maintained at such a rate.

A Swedish Hydro-Electric Installation.

Our issue for Jan. 2 contained an editorial comment on the advantages to be gained from the storage of water for hydro-electric installations. On page 101 of the present issue there appears a description of a Swedish plant in which storage is to be carried to such an extent that the minimum flow, which previously reached a value as low as 10 cu. m. per second throughout four months of each year, will be increased to 20 cu. m. per second. In the installation described the regulation

of the flow will present no great difficulty because the water is obtained from Lake Asnen and from Lake Rottnen, which, by means of inexpensive dams, will be treated as storage reservoirs. In the meanwhile, until the arrangements for regulating the flow of the water from the lakes have been completed, the electric company has been enabled to make advantageous agreements with certain consumers now electrically equipped for the use of their idle generating machinery in case of low water; this machinery, which the service of the company will render superfluous, will be held as reserve for the company's benefit during the early stages of development. This equipment represents one of the very few cases where the installation of machinery in excess of the power obtained at minimum flow is justified.

The electrical portion of the Swedish equipment described is similar in many respects to installations commonly employed for similar purposes in this country, but differs therefrom in certain details. The European standard frequency of 50 cycles can hardly be regarded as a compromise between our 25 cycles for general transmission and 60 cycles for distribution to lamps, but it is sufficiently high for any type of lamp and is not excessive for most types of motors. The e.m.f. of 40,000 volts for a 60-mile transmission line, or about 700 volts per mile, corresponds to values selected for such distances in this country. An interesting element of the line is a short section in which a cable with a hemp core is used. The advantage claimed for this cable is that the strain is distributed over the strands more nearly uniformly than when a wire core is employed. It would seem that such a construction might increase the factor of safety in a seven-strand cable by about 17 per cent. The use of this cable is limited to road crossings, where extra precautions are taken to eliminate all danger-to-life features. Elaborate protective devices have been installed at railway crossings, whereby any falling conductor becomes grounded before it reaches a position in which it could cause damage to persons or animals. The plan of grounding everything not forming a part of the conducting or the insulating system has been used throughout the whole installation, including the generating stations, the transmission lines and the substations. The arrangement is such that any defect in the insulation will cause a conductor to be grounded, thereby affording maximum protection to life with a negligible increase in the liability to shut-down in case of insulation failure.

Rates for Utilities.

This week the United States Supreme Court has issued two important decisions on the rates that may be fixed for utilities. One ruling affects the famous 80-cent gas laws in New York, and the other applies to an ordinance reducing the price of water at Knoxville, Tenn. The same principle governs broadly in both cases, viz., that if it is not shown that the rates are unfair and confiscatory they are not unconstitutional. Incidentally, in the New York gas ruling it is held to be unconstitutional to insist on certain standards of pressure and candlepower required by the law; and the penalties imposed are held to be void. Moreover, the valuation of the franchises at the time of consolidation is held to be fair, but the gain in franchise value that was predicated is also regarded as not substantiated. It is early yet to express any deliberate opinion on the decision, of which only a memorandum was given out by Justice Peckham, but at this time we must note the apparent limitation of the company to a 6 per cent return on its investment. We find it hard to see why a company should not legally be entitled to earn more if efficient management will enable it to do so, sharing its greater gains with the public. There is no a very warm invitation to new capital in such a rate, and all the public utilities are in constant need of new capital. In passing, we note that on the news of the decision the price of the gas stock fell to about 140. But that is not a bad price for a 6 per cent security—if it were a bond.

National Advertisers and Electric Signs.

Electric sign advertising is well established as a form of publicity around all large cities, but it is probably true that there are so many undeveloped possibilities in connection with it that the present state of the electric advertising art may be looked upon as only a beginning. A number of concerns doing advertising the country over are making considerable use of electric signs in various cities. Nevertheless most of the efforts of the new-business departments of large central stations have been devoted to canvassing local advertisers rather than to traveling over the country for the purpose of enlisting the interest of concerns which are introducing their products to the entire country. As intimated by Mr. Henry L. Doherty at the last National Electric Light convention, a movement is on foot to educate the national advertisers to the possibilities of electric-sign advertising. As noted elsewhere in this issue, the central station at Denver has begun to make active efforts to secure this class of business by sending out a representative to visit these national advertisers, and the results to date have been most encouraging. Any work of this kind done by one company at this stage of the business helps all, as there is much to be done to get electric-sign advertising recognized as fully as the other means used by large advertisers.

A Fallacy in Lighting Design.

It has been customary in planning many lighting installations to provide for two intensities of illumination by having each cluster, chandelier or group of lamps arranged with two or three circuits, so that the number of lamps turned on can be varied. We do not wish to decry the employment of this plan where there is good reason for it, or where it involves but little expense or complication. However, there has been a tendency to run this idea into the ground, and to add needless expense and complication to a lighting installation through a misunderstanding of the actual requirements. The number of places where two or three intensities of artificial illumination are required is much less than might commonly be supposed. For example, in providing for the general lighting of offices or stores, it is erroneously argued that during cloudy weather, or for a short period before darkness each evening, it will be desirable to turn on less than the whole number of lamps on a fixture, cluster or group because of the assistance given by daylight in the general lighting of the room. As a matter of fact, the occupants of the room will demand more artificial illumination during the transition period from daylight to darkness than they will demand after darkness has fully set in. Daylight illumination is usually of much higher intensity than artificial illumination. During the transition period from daylight to artificial light, the eye has not become accustomed to working with the low intensities of artificial light, and, furthermore, the presence of natural light coming through the windows tends to keep the iris of the eye contracted to accord with daylight con-

ditions. Therefore, nothing short of the full amount of artificial illumination that is ever available will satisfy the users during the transition period from daylight to darkness. The legitimate place for the use of two or three circuits to give different illumination intensities is where a high degree of illumination is not required all of the time during the hours of darkness, but where it is, nevertheless, desirable to have some light. Such a condition sometimes obtains in the halls of public and office buildings, although frequently the same object can be accomplished by turning off the lamps on some of the fixtures rather than having two or three intensities from one fixture. In the lighting of these halls during the daytime, however, it will usually be necessary, if any artificial light is used at all, to turn on everything available, in order to bring the illumination in the halls up to an intensity as near as possible to what the eye is accustomed by daylight.

THE ECONOMICS OF LIGHTING.

The coming of new and efficient illuminants has awakened great interest in the economics to be secured by their use. What is even more important, it has stimulated actively in making the best use of all illuminants. If one stops to consider the subject, it is at once apparent that the result sought is illumination, and the means whereby one secures it is by the input of energy in some form for which one has to pay. And so far as cost is concerned, the effectiveness of the installation is determined not merely by the efficiency of the illuminant, but also by the cost of securing an illumination of one or several foot-candles over the required area. In fact, doubling the efficiency of the illuminant may be less economical than doubling the efficiency of its utilization, since the new sources of light generally cost more to install and maintain than the older ones. To secure the highest economy one must not only use the most efficient sources, but must employ them to the very best advantage. The dollars and cents side of the problem is evidently important, yet it has been sadly neglected, not by intention so much as by lack of proper care. The result has very often been far more serious than it would seem at first thought.

One must remember that the cost of lighting a room or a building is a continuing charge, so long as room or building is in use. An inefficient installation is a steady item of expense which, if capitalized, may amount to a sum worth serious consideration. For example, suppose some unskilled person has laid out the lighting of a church and has used, by reason of improper location and shading of the lights, twice as many incandescent lamps as were necessary to give the result. If the whole charge thus incurred amounts to $50 per month, one-half of it, or $25, per month represents the cost of the ignorance of the man who did the work. This especial example chances to be from an actual case. If one capitalizes this charge, say at 5 per cent, the fact appears that it would have paid to spend several thousand dollars in getting that particular job of lighting thoroughly well planned and executed. The same thing constantly occurs on a smaller scale. Assume, for example, that a man is building a house and that his architect designs a fine large library to be finished in dark wood and dull green or red paper. It is a demonstrable fact that such a finish, even with a very light ceiling, requires to produce a given illumination about three times as much light as if the finish were light. If four 16-cp incandescents would do the work in a light room, 12 will be needed with the dark walls. Assuming half a cent per lamp per hour as the cost of energy, and that the lamps are used three hours per night for 300 nights per year, the continuing charge against the dark finish amounts to $36 per year. There is no doubt that such finish may be artistically good, but the owner should be brought squarely face to face with the question as to whether it is worth to him an increase of $3 a month in his running expenses. One often finds rooms, too, in which the finish and the improper location of inadequate fixtures unite to produce a condition in which proper lighting is practically impossible.

Even such cases can sometimes be helped by a complete revision of the fixtures and wiring plan, but the long bill which comes with such work in a finished building is not always gratefully received. One can find numberless rooms in which similar thoughtlessness is evident and costly. If well-planned lighting were extremely difficult or expensive, there might be some excuse for this state of things, but, on the contrary, it is neither. The most fruitful sources of failures lies in the fact that lighting is frequently an afterthought and, by the time it comes under consideration, is considered almost as an extra expense coming upon the top of extras already burdensome. The job of wiring goes to the lowest bidder on the cheapest plans, and while he may do honest work, the result is likely to be bad. If people fully realized the continuing charges against badly-planned lighting, they would be willing to go to some expense to gain final economy. Proper lighting can be very readily predetermined, and there is really no excuse for failure unless the character of the fittings is radically changed after the lighting plans have been executed. This should very rarely be necessary if there has been reasonable foresight at the start. In cases where there may be radical alterations of finish after the completion of the building, one should, as it were, take out insurance by putting in a wiring system capable of taking care of the worst conditions likely to be met later, even if part of the outlets is capped and left out of sight. And the same precaution should be taken when a building is subject to considerable change of use. A small amount expended at the start will often obviate heavy alteration charges against the lighting system, as well as the steady waste due to inefficient methods.

ELECTRIC RAILWAY DEVELOPMENT IN 1908.

Since the most important application of electricity to the existing and future problems of transportation will lie in its gradual utilization in trunk-line service, it is opportune to consider the tendencies in this direction in the last 12 months. This larger aspect of the uses of electricity in transportation comprehends its more general adoption in three ways: (1) For long distance tunnels; (2) at congested terminals of steam roads which furnish transportation service to suburban communities; and (3), in strictly trunk-line service where severe grades or the density of traffic are sufficient to justify the investment and service required to make the use of electricity as a motive power profitable. Development in all of these directions has been slow within the last year, more on account of financial than any other reason. Important electrification work, however, has been completed or is projected and calls for mention here as indicating a certain development of the times.

The creation of trunk lines of electric railway may be effected through the electrification of existing steam railroads or the consolidation of so-called interurban properties. The construction of interurban track, notably in the Central West, has proceeded to a point where it has made long rides possible; many links of connection between different properties have been built and through routes established, which will lead in time, inevitably, to consolidations and greater systems, permitting economies and improved service for the public.

Important installations which were completed during the year comprise part of those contemplated by the New York Central & Hudson River and New York, New Haven & Hartford roads, the St. Clair tunnel and the Hudson & Manhattan Railroad. Extensions of both the New York Central and the New Haven electric service will be made. The plans of the management of the Pennsylvania Railroad with respect to the New York tunnel were progressed further by the decision to use direct current. Noteworthy installations are assured through the electrification of the Cataract tunnel line of the Great Northern Railway and the work undertaken and projected on Western lines of the Southern Pacific Company. The decisions of the Illinois Central Railroad in relation to the proposed electrification of the terminal at Chicago and of the Chicago, Milwaukee & St. Paul Railway regarding the mountain division of the Pacific Coast extension, assure notable improvements. Unless conditions change in 1909, there is no reason to doubt that further efforts to extend the uses of electricity in the larger problems of long-distance transportation service will be considered without serious delay.

Voltage Strains Due to Circuit-Breaking in Direct-Current Systems.

It is well known to all who have experimented with direct-current circuits in a practical way, that when such a circuit is closed suddenly under full voltage, the current does not rise to its full strength for an appreciable period of time; and, on the other hand, when such a circuit is suddenly broken, the current persists for an appreciable interval, usually in the form of an arc. The first condition is utilized in practical work, as a safeguard against short circuits, because a man accustomed to switchboard and connecting work gets into the habit of flashing a contact quickly before closing it finally. The elastic recoil of the metal connections, when they are first struck together, separates them in a small fraction of a second, and before a current, destined to be violent, can attain large proportions. The second condition has to be safeguarded in various ways to prevent disastrous results, and circuit-breakers of various kinds are used for preventing the arc following metallic rupture from becoming dangerous.

The cause generally accepted for the above-mentioned behavior is electromagnetic inertia. When current flows in a circuit, it establishes magnetic flux linked therewith. This magnetic flux resists being created, changed or dissipated. It possesses energy. Energy must be expended electrically by the voltage source in creating the magnetic flux, and this energy disappears back into the circuit, as the energy of extra current, when the circuit is broken. The greater the inductance in the circuit, the greater will likewise be the magnetic energy associated with a given current strength, and the greater the voltages involved in changing the current. Moreover, as the current in the circuit increases, the magnetic energy, that must be dissipated when the current dies away, increases as the square. One of the well-known devices for safely breaking a powerfully inductive circuit, such as the field-magnet circuit of a large dynamo, is to cut in resistance, such as incandescent lamps, before metallic rupture. Field-magnet switches are commonly provided with an auxiliary contact for throwing in such non-inductive resistance before the rupture of the circuit contact. By this means the current is allowed time to weaken before it is broken at the contacts, and since the magnetic energy released falls off as the current squared, the final flash is reduced to safe dimensions.

Mr. L. Silberberg, in his article on page 107, this week, examines mathematically the behavior of voltage and current in a direct-current circuit, of negligible capacity, when a circuit is broken by introducing non-inductive resistance at a definite rate, some power of the time elapsing from first insertion. He shows that, in general, the voltage will rise to a certain maximum, while the current falls off with a speed which reaches its maximum at the same instant. Theoretically there will be a certain way of cutting in resistance that will make the least voltage rise. In such a case there would theoretically be no arc. The magnetic energy of the circuit would be all absorbed in the extra included resistance. The case is then considered of an arc formed between the carbon points of a rapidly and widely opening circuit-breaker, assuming that the cross-section of the arc varies as the current at any instant, and that the length of the arc is in direct proportion to the elapsed time. In particular cases of such action it is computed that the voltage keeps on rising until the magnetic energy is all expended and the current stops. The induced voltage then collapses instantly. It is not pretended, however, that the above assumptions apply rigidly. The actual conditions are probably more complex, and can only be inferred from experimental observation in such cases with the oscillograph. It seems quite likely, however, that, in general, opening a circuit on extra non-inductive resistance can be relied upon to produce a maximum voltage before metallic rupture; whereas, opening a circuit on an arc between swiftly moving electrodes produces a maximum voltage at the final rupture of the arc.

The Central Station.

In spite of a year of rather hard times the central-station business has upon the whole held its own remarkably well. It is sensitive to business conditions in some particulars, yet persistent effort has held up the volume of business in a very gratifying manner. It is not, of course, to be expected that the business of central stations can hold a rapid rate of increase indefinitely, and the time must come when the rate slackens unless new channels of output are found. Such channels can be found and ought to be sought more vigorously now than ever before. If one sits down and looks over the field of demand for central-station output, he will find that it has been very irregularly tilled. Even in the case of lighting—that old standard crop that has been in the past so profitable—the harvest is not what it might be and ought to be. So far as the larger cities are concerned, and to a certain extent everywhere, the failure is in neglect of the business to be derived from the relatively small consumer. He is not so profitable an individual as the large consumer, but as a class he is, or ought to be, an ample source of profit. Anyone who has doubts about this may well be recommended to sit down and carefully read the yearly

report of his particular competing gas company. If he stops to consider it, he will find that the aforesaid company has as its chief source of income the small consumer, and that upon the profits made from him it earns its often liberal dividends.

Now, of course, an adept bookkeeper can solemnly figure out that the small consumer is a source of net loss. Perhaps at times he may be, but if he were so as a rule the gas companies would die of starvation. If the electric central station finds its steady charges on behalf of the chap who uses only 25 kw-hours per month or so, are prohibitive, that central station needs to look sharply after its methods. Then as the next step, it would be worth while to examine the gas-engine situation. Every gas-engine user is potentially a customer for an electric motor. Why is he not an actual customer? A hard drive after motor business generally brings its reward if the central station is really out after business. Then, finally, comes the electric heating and cooking apparatus. A recent discussion of this topic indicates that such apparatus uses current up to about its own price yearly—certainly a mass of business worth going after. In point of fact, the customer who yields the largest ratio of profit on most central-station service is neither the very large one nor the very small one, but on most schemes of discount he is nearer the latter than the former.

The one conspicuous thing in central-station practice this year has been the irruption of the tungsten lamp. Everyone has wanted for years a more efficient incandescent lamp, and now that he has got it, wonders how on earth he had better manage the thing. By and large, the problem is working itself out pretty well, yet the details are still puzzling. It is far too early yet to get reliable reports of progress from the few stations that have undertaken to give free renewals of tungsten lamps. Such a policy is, of course, equivalent to a very material reduction in rates—a reduction proportionately larger as the consumer's price per kw-hour is lower. Whether a given company can comfortably stand the reduction depends on the price that it is getting at the start. On the other hand, throwing the whole of the cost of the new lamps on the consumer in lieu of free replacement of carbon lamps, would be equivalent to raising the price of energy, while at some point between this and free renewals, the virtual price of energy remains unchanged. The whole situation is therefore in great measure under control, though it is not easy to lay down the wisest course. One very encouraging feature of the case is that there seems to be not the slightest danger of any material decrease of demand for energy owing to the greater economy of the new lamps. Increased use by old customers and the acquisition of new ones keep the balance at least even. The only loss worth considering is the wholesale scrapping of arc lamps that have been replaced by tungsten lamps. That is, of course, only part of the depreciation due to change in the art that always enters into station economies—in this case rather more suddenly than usual. It is very clear that the enclosed arc in its familiar form is doomed, and is being rapidly supplanted. There is no ground in this for considering that all arcs are doomed, although thus far it is not altogether easy to pick out the forms most likely to survive. The question of proper color value is the chief one here to be considered for commercial lighting, and it seems now to be best met by some of the intensive carbon arcs with slender electrodes—a type that deserves greater prominence.

THE STORAGE BATTERY.

There has been no noteworthy advance in the storage battery art nor its engineering applications, during the past year, which is to be attributed to two causes. One of these has naturally been the widespread stagnation in industrial enterprises of every kind which marked the year 1908, and the effects of which were felt more seriously in the storage-battery field than in any other branch of the electrical industry, thus greatly reducing the incentive to experimentation and original development. The other cause is that by the middle of the year 1907 the art had attained such a high state of perfection that all existing engineering requirements were adequately met. In the matter of technical detail, however, it is interesting to note what might be termed a reversion to the types of Planté plates as they existed some years ago. For many years the efforts of all designers of Planté plates have been toward increasing the active area, and therefore the minuteness of subdivision of the base lead, which forms both the material from which the active oxides are produced and the conducting support on which they are carried. Improvements in scoring and grooving machinery, in casting thin leaden webs under pressure, and lead squirting through dies, were continually made, and the resulting electrodes became more and more subdivided, with a consequent increase in exposed area, and therefore of capacity, for a plate of given weight and dimensions. Under continuous service, however, it became evident that positive electrodes of this character had short lives, owing to the gradual but inevitable loss of peroxide and its automatic replacement from the underlying lead support. Slowly manufacturers have had forced on them the understanding that the life of a positive plate of the Planté type is a direct function of the thickness of the base lead, and within the past year two of the larger manufacturing companies have modified their positive plates by increasing the thickness of the leaden webs, thereby greatly increasing the durability of the plates, as well as their weight and cost, and decreasing the capacity per square foot of active surface.

During the year 1907 there were a few applications of storage batteries to alternating-current systems supplying energy to fluctuating loads. The first efforts along this line, while successful, exhibited certain crudities inseparable from experimental mechanism. During the past year the auxiliary devices necessary for battery installations in connection with alternating-current systems have been greatly improved and almost brought to the condition of standard apparatus. Among other of the auxiliaries which have received attention and consequently undergone improvement during the past year, the split-pole rotary converter and the alternating-current boosters may be mentioned as the principal ones. The former machine has been frequently referred to in these columns and is now well known in the art. It is, in effect, a rotary converter which may have its voltage varied on the direct-current side, within wide limits, with a constant alternating voltage impressed on the slip rings, and, of course, operates reversibly. By automatically varying the voltage on the direct-current side, charge or discharge of the battery is effected on the usual manner.

The alternating-current booster is used with the ordinary rotary converter, which latter always gives at the commutator a voltage that bears a definite ratio to the impressed alternating voltage. The function of the alternating-current booster

is to raise or lower the voltage of the alternating current supplied to the rotary converter, and thereby to vary the direct-current voltage in accordance with the requirements of the load fluctuations on the system, in this manner causing charge or discharge of the battery with load changes. The alternating-current booster is simply an alternating-current generator in series with the rotary converter, being connected between it and the supply circuit. Its field excitation is controlled as to direction and magnitude by any form of automatic field regulator which is applicable to the field regulation of the ordinary direct-current booster. The voltage applied at the slip rings of the rotary converter is changed with load changes in the main alternating-current circuit, by the action of this booster, and the regulation of alternating-current systems thus accomplished.

One real benefit which may be attributed to the otherwise unfortunate financial conditions that have prevailed during the past year is the reduction of prices of storage batteries. For each small reduction in the cost a new field of application is opened. A peak may be taken by batteries more economically than with generating apparatus if the cost of the former be reduced. It may therefore be expected that with improvement in industrial conditions, storage batteries will be used more extensively than they have been in the past, if the prices accord with the necessary economic considerations.

Electric Power Transmission.

The record of the year just gone in electrical power transmission has not upon the whole been a very striking one. It has been a sort of plain, uninteresting "standard" practice, from which, however, rises one towering landmark in the Grand Rapids 110,000 volts. The rather hard times have checked anything like successful promotion of hydro-electric enterprises, and while a considerable number of minor plants have gone into operation, there has been no one of them save in the instance mentioned that has been distinguished above the ordinary. To tell the truth, hydro-electric transmission had just at the present time fallen into a rather bad way. The time has gone by when desirable hydraulic privileges could be had for a song. Getting a plant through the various stages from the acquisition of the riparian rights to the sale of power is a pretty serious business since people have been aroused to a perhaps exaggerated idea of the present value of water. The revelations of scant water supply and high costs contained in a recent issue were no surprise to the engineers who have followed the game, although they may come as a shock to the neophyte. In the last analysis, however, they need not be at all discouraging, albeit they point a moral.

Comparisons between the costs of water power electrically transmitted and steam power are apt to be fallacious in that they are not reduced to the same plane of reference, so to speak. Steam plants are as a rule installed in the interest of some already existing enterprise to do a certain existing task as economically as possible. The costs are kept down by rigorous competition and a definite knowledge of the results to be accomplished. The general expenses and fixed charges are down to bed rock and the output is predetermined. A hydro-electric plant, on the other hand, is a thing that is generally "financed" by somebody with an eye to profit on the bonds and rarely with the discretion that would be exercised were it being paid for directly by its permanent owners. There is, therefore, a tendency to development on the basis of possible rather than certain profits, and very often both the immediate market and the development are exaggerated, with the result that both fixed and operating charges are too high. That many plants so built can still compete as they do successfully with steam, is the strongest possible evidence of the real value of hydro-electric properties. But it is not in the least surprising to find that in many cases steam power can under the circumstances fully hold its own. Even in hydraulic plants which are conservatively financed, high development costs and unfavorable load conditions may seriously increase the expenses. Usually the hydraulic plant is really duplicated by a steam plant installed by way of auxiliary, which still further increases the expense. The best economic results can be looked for only when the plant does not have to carry any large burden of this kind.

Networks operated from a group of plants give about the best chance for low costs since in such case the dead capital can be reduced to a minimum, assuming that the network is not the result of a costly consolidation process. The great step forward in working voltage taken by the Grand Rapids plant is from this point of view especially encouraging. Operation at 110,000 volts implied the probability of covering economically an extent of territory hitherto considered quite impracticable. As compared with the highest pressures hitherto used, it cuts down the cost of conductors to about one-third of the former figure. This sounds big, and is big if large amounts of power are to be transmitted over very long distances. But in point of fact, while saving in the copper is important, in the ordinary transmission line the conductors represent only a quarter to a half of the total costs on which fixed charges have to be paid. What profits it a man to gain $300 or $400 a mile on his copper by raising the voltage, if he expends twice these amounts in steel and insulators? As a matter of fact, the Grand Rapids line is pretty economically constructed, but it is safe to say that it will be for some time exceptional in this respect. We Americans are very backward in the matter of economical line construction. We have been bluffed to a standstill by Ananias Mossback, the Oldest Inhabitant, with his tales of the terrible storms of 1821, and build lines as if we were going to string the chain cables of a battleship instead of No. 1 B. & S. There is very little object in going to extreme voltages unless one is prepared to take full advantage of the reduction in his copper and is willing to plan his line as an engineering structure. When this is done, we shall begin to realize the enormous value of high voltage in prompting the organization of extensive networks aggregating the power of groups of hydro-electric plants and reducing greatly the amount of reserve plant necessary for the system. There are some excellent lessons in this particular to be learned on the coast even now. Meanwhile, the bold step forward in the 110,000-volt transmission gives practical experience, the value of which can hardly be overestimated, in the control of the pressures that sooner or later must come into wide use and are necessary to the conservation of the world's resources.

Prime Movers and Electrical Generators.

The industrial depression of the past year has not been conducive to bold experiments or wide departures from accepted standards in electrical generation practice. At the same time this very condition has induced a more careful study of the conditions of economy, and definite progress has been made in the standardization of certain of the factors entering into the

general problem of the economical development of power, and in a more definite and intelligent appreciation of their relative importance. In the matter of fuel supply, the condition has changed but little. Coal still prevails as the standard for power-plant service and this condition seems likely to continue until the arrival of some readjustment below the horizon of the present outlook. When oil or liquid fuel, however, can be bought at a price per barrel equal to or less than about one-fourth the cost of coal per ton, the oil will prove the more economical fuel, and in sections of the country where these conditions prevail the standard fuel is of the liquid type. Perhaps the most significant feature in connection with the problem of the efficient combustion of fuel is the increased attention which the question of draft and its regulation has recently attracted. The use of carbon dioxide indicators or recorders is becoming more common in marked degree, and the regulation of draft as a factor of fundamental importance is more adequately and widely recognized than ever before. An interesting illustration of the importance assigned to this factor is found in the design of the new Pacific Light & Power Company's plant at Redondo, Cal., the details of which were recently published in these columns.

The problem of the boiler has been one simply of selection between a large number of varieties, all of the water-tube type and exhibiting the same underlying principles of design. The problem of the prime-mover remains much as it was a year ago. On the whole it may, perhaps, be fairly said that the turbo-generator combination has acquired a still more definite status as the typical unit for normal or average conditions as presented in central-station practice, especially in large sizes. As already pointed out in these columns, this is not due to superior degree of any one factor, but rather to a general estimate of superior adaptation to the all around demand and conditions of central-station service. In this connection note should be made of a most interesting series of answers obtained by a committee of the American Street and Interurban Railway Engineering Association in response to a series of questions which they submitted to a large number of users of prime-movers of both turbine and reciprocating types. These replies, abstracts of which have here appeared, indicate a wide divergence of opinion on certain of the points submitted, while on others a general trend of view may be determined. The individual replies, in fact, are of small value except as they may be interpreted in the light of the special circumstances of the case, and in the absence of detailed analysis in the light of such circumstances, only certain general indications can be drawn. As they stand, however, they indicate, as often repeated in these columns, that under generally similar and comparable conditions the turbine and reciprocating engine belong both in the same class as regards economy; that the anticipated superiority of the turbine in the matter of quickness of starting has not been realized, as a period of warming up, especially with large units, is quite as important as with the reciprocating engine; that the labor costs of operation are somewhat in favor of the turbine, and that the general costs of maintenance are likely to compare somewhat in the same manner.

Some attention has been directed to the possibilities offered by the reciprocating engine and the so-called low-pressure turbine in tandem combination. The possibility of useful adaptation of such a combination should be held in mind with reference to use in the case of suitable conditions, and it seems not unlikely that there may develop some field of usefulness for such hybrid combination of prime-mover types. Some progress should be noted in the line of turbines of medium and small size, but the field of medium and small-sized power units has been and is still definitely held by the reciprocating engine. This covers a field of the widest extent and of the highest industrial importance, and includes small power stations, isolated lighting and power plants, mills, industrial plants of all types and the auxiliary steam machinery of large central power stations. With the improvement and marketing of small turbine units in sizes of 25 hp and upward, a third factor will appear in the field, and in central-station practice it is not unlikely when steam-driven auxiliaries are preferred that the small turbine will find a field of useful service.

The internal combustion engine as a prime mover in central-station practice has perhaps acquired a somewhat more definite status during the year. At the National Electric Light Convention of last year a report, abstracted in these columns, was submitted by a committee appointed to investigate the general question of the relation of the internal combustion engine to central-station requirements. The general conclusions of the committee were that while complete installations of a character that would have a direct bearing on central-station practice have not existed a sufficient length of time to furnish operative data of any great value, gas engines in large sizes have been in service long enough to demonstrate that continuous service is obtainable; that gas engines in standardized designs are available in sizes ranging up to 5000 hp; that builders differ widely as to ratings, making it difficult for the buyer or designer to make intelligent comparisons; that speed regulation has been so improved that the most reliable builders are now prepared to guarantee parallel operation with either 25-cycle or 60-cycle electrical units; and lastly, that the producer has not reached a stage of development corresponding to that of the engine. This report presents the case with respect to large rather than medium or small plants, and indicates that the gas engine in the case of the former class will lag until somewhat more of assurance can be furnished regarding the requirements of reliability, continuity of service and general cost of maintenance.

In small sizes and for isolated service of all types the internal combustion engine is making rapid progress and is demonstrating adaptability of a high order. This places it immediately as a factor in the field of small or isolated lighting and industrial power. Where economy in the cost of power is a matter of primary importance, the use of engines of this type is fixed by a fuel cost per hp-hour not exceeding in any marked degree that for the steam prime mover. This excludes the use of gasoline, kerosene, the various forms of engine distillate and municipal gas at usual rates, but leaves the various forms of producer gas drawn immediately from coal or oil as the fuel source. The producer using coal as fuel and of various types and forms has achieved a very considerable measure of success and there are good prospects of equally satisfactory results with the use of oil as fuel. With these fuels readily available and with an economy of about 1 lb. per hp-hour, and with an investment lying between the fuel and the engine not larger in marked degree than that represented by the boiler in the steam-driven plant, the internal combustion engine in moderate sizes bids fair to acquire rapidly a position of increasing importance in the industrial world, and as such will find increasing service in other than the larger electrical generating plants.

United States Supreme Court Decisions Uphold Rate Making.

The United States Supreme Coutr, at Washington, on Jan. 4, handed down two important decisions both of which supported the principle of rate making by proper authorities, as applied to public utilities. One case was that of the Consolidated Gas Company of New York against the 80-cent gas laws of 1905 and 1906, under which the gas consumers of the city have paid in $9,000,000 in excess of the rate, under a ruling by the lower U. S. Circuit Court that $1 should be paid, until the status of the laws had been determined by the final tribunal. The legal fight over the constitutionality of the laws has waged for some three years and has been a sharp contest in all the courts. Apparently in its decision, which is unanimous, the Supreme Court does not specifically say that the laws are constitutional, but holds that they have not been shown to be unconstitutional. In anouncing the decision of the court, Justice Peckham said:

"First—At the time of the consolidation the value of the franchises of the constituent companies was fixed by them at $7,781,000, and that amount formed part of the capital of the complainant for which it issued the stock. The consolidation was effected pursuant to the State statute, and the State has never questioned the validity or fairness of the valuation.

"Since the consolidation the stock so issued has been dealt in up to the present time as valid stock of the Consolidated Company, capitalized pursuant to the statute at not more than the fair aggregate value of the property, franchises and rights of its constituent companies. The State should not now be heard to question the value of the franchises at the time of the consolidation. The method of arriving at the value of these kinds of franchises and how they should generally be tested in the fixing of rates are questions not now before the court and are left undecided. The case before the court is decided upon its own peculiar facts.

"Second—The estimated increase in the value of these franchises as made by the trial court at the time of the commencement of this suit is only an estimate and is not based upon evidence sufficient to warrant the finding of any increase whatever over the amount agreed upon at the consolidation.

"Third—The evidence leaves it in doubt whether the value of the property used by the company in its business is as great as found by the trial court after reducing the value of the franchises to the sum agreed upon at consolidation.

"Fourth—But taking the value as found by the court, after reducing the value of the franchises, the result gives a return of almost 5½ per cent. A reduction in the value of the real estate, plants, etc., of a small amount only would bring the return to if not more than 6 per cent. A possible increased consumption of gas would probably increase the earning of the company without a corresponding increase of cost.

"Under all the circumstances the complainant has failed to make out its case with that degree of clearness necessary to warrant the interference of a court of equity before an actual and bona fide test has been made under the practical operation of supplying gas at the rates mentioned in the statutes.

"Fifth—There is no rule as to any particular rate which any corporation subject to legislative control in the matter has a right to obtain without legislative interference. It depends upon circumstances and locality. In this particular case with reference to the risk attending the business and the locality where it is carried on, the complainant is entitled to a return, if it is possible, of 6 per cent upon the fair value of its property actually used in its business of supplying gas.

"Sixth—There is no discrimination between the individual consumer and the city, by fixing the price of gas for the city at five cents per 1000 cu. ft. less than is permitted in the case of individual consumers, so far at least as the complainant is concerned.

"If the amount obtained from the total gas sold to the city and the individual is enough to secure the requisite return upon property, it is all the complainant can require, and the question of discrimination between city and individual is one in which the complainant can have no interest.

"Seventh—The rate proposed must be with reference to the value of the property at the time when the rate takes effect. The company is entitled to the benefit of any increase in value at that time. This at least is the general rule, and if there be any exception to the rule, this case does not come within it.

"Eighth—Any increased expense arising from the increased candle-power of the light demanded by the statutes was included substantially in the expenses of the year (1905) with reference to which the inquiry was made.

"Ninth—The provision in the acts requiring a certain pressure is unconstitutional. The proof unquestionably shows great possible if not probable danger of explosion in the mains or other pipes, if the pressure demanded were applied to them as they now are. To eliminate such danger would require strengthening all the mains and other pipes, which would involve an expenditure of many millions of dollars upon which no return could be obtained at the rates prescribed by the acts. The provision can be separated, however, from the rest of the statute and the balance thereof made valid. The pressure must be sufficient to produce a light of the candle-power mentioned in the acts.

"Tenth—If the court below is right in its construction of the penalties, as to their amount, etc., such penalties are void, but are separable from the rest of the acts, and the balance can be effectually carried out.

"Eleventh—This is not a case for the valuation of good-will. The complainant has in fact a substantial monopoly of the gas business in the city of New York, and those who wish to use gas must take it from complainant. In this case, as there is no possibility of competition, there should be no allowance for good-will.

"Twelfth—As it may possibly be that a practical experience of the effect of the acts by actual operation under them might prevent the complainant from obtaining a fair and just return upon its property used in its business of supplying gas, the complainant, in that event, ought to have the opportunity of again presenting its case to the court. Therefore, the decree is reversed with directions to dismiss the bill without prejudice."

The decision was concurred in by the entire court.

The Supreme Court also reversed the judgment of the Federal Court in Tennessee enjoining the city of Knoxville from enforcing an ordinance reducing the price of water to consumers. The court below, said Justice Moody, had made errors in determining the value of the property and the amount that would be a fair return on the investment, and therefore the price fixed by the ordinance was not confiscatory. The action of the water company also was premature and the State courts should have been first appealed to for relief.

Regulations of New York Commission Governing Schedules and Forms of Contracts.

Final regulations have been adopted by the New York Public Service Commission, First District, prescribing the form and governing the construction and filing of schedules of rates and forms of contracts of electrical corporations. An abstract of the tentative form of the order of the commission on this subject was published in the Electrical World of Nov. 14, 1908, page 1053. The final order follows closely the intent and language of the tentative order, but a few changes were made in response to representations of the companies. The tentative provision that every schedule should contain an exact copy of the form of bill to be rendered under each contract, showing how bills are computed, was omitted from the final order. The original form provided that printed copies of all schedules and supplements in force, or to be placed in force, should be kept on hand at every office in sufficient supply to meet promptly any reasonable demand, but the final order does not go further in this respect than to provide that such copies shall be kept posted in two conspicuous places in the offices.

Nothing in the order is to be construed as applicable to schedules of rates and forms of contracts relating to service rendered to the city or State of New York, except that every corporation is required to file with the commission a copy of every contract relating to such service within 10 days from the date of contract.

The order is to take effect on Jan. 15, 1909, and to continue in force until abrogated or modified by the commission. All schedules, contracts and riders filed and posted before Jan. 15, 1909, are to go into effect on Jan. 15. Every corporation within the jurisdiction of the commission was required by the terms of the order to notify the commission on or before Jan. 2 whether the terms of the order would be accepted and would be obeyed.

American Patent Revoked in Great Britain.

On Jan. 4 the British Comptroller-General of Patents revoked an American patent under the new British patent law, on grounds which indicate that the law is to be drastically enforced. The patent was for an American sewing machine in which a few minor parts were removed and replaced by others made in England. The defendants pleaded that it was scarcely possible to manufacture the machine entirely in England owing to the lack of the necessary tools and the highly skilled labor that was essential, but it was ruled that the American patentees had not adequately worked the patent by merely making a small number of substituted parts.

Condensed Operating Expense Accounts for New York Electrical Corporations.

Under the system of accounts for electrical corporations, prescribed by the New York Public Service Commission, Second District, for introduction beginning Jan. 1, 1909, some of the accounts are condensed for companies with gross operating revenues from electric operations of less than $500,000 a year, but $100,000 or over. A second condensation is made for corporations with similar revenues of less than $100,000 a year, and a third for corporations with less than $25,000 a year. The condensation applies principally to the operating expense account, except in the third condensed scheme.

The titles of the primary accounts in the complete scheme for corporations with revenues of above $500,000 were published in the ELECTRICAL WORLD of Dec. 12, 1908, page 1281. The primary operating expense accounts for the corporations with smaller revenues are as follows:

CONDENSED OPERATING EXPENSE ACCOUNTS.

For Corporations with Gross Operating Revenues of $100,000 to $500,000 a Year.

I. Production expenses.
- Station superintendence and labor.
- Fuel for power.
- Water for power.
- Lubricants for power.
- Production supplies and station expense.
- Repairs of power plant buildings.
- Repairs of furnaces, boilers and accessories.
- Repairs of steam engines.
- Repairs of hydraulic power plant.
- Repairs of gas power equipment.
- Repairs of power plant electric equipment.
- Miscellaneous station repairs.
- Steam from other sources.
- Power gas from other sources.
- Electric energy from other sources.

II. Transmission expenses.
- Transmission subway rent.
- Transmission pole and fixture repairs.
- Transmission underground conduit repairs.
- Transmission system repairs.
- Substation labor.
- Substation supplies and expenses.
- Repairs of substation buildings.
- Repairs of substation equipment.

III. Electric storage expenses.
- Electric storage expenses.

IV. Distribution expenses.
- Electric distribution superintendence.
- Electric distribution records and expense.
- Setting and removing meters and transformers.
- Distribution subway rent.
- Distribution pole and fixture repairs.
- Distribution underground conduit repairs.
- Distribution system repairs.
- Repairs of electric services.
- Repairs of transformers.
- Electric meter operation and repairs.

V. Utilization expenses.
- Commercial arc operation.
- Commercial arc repairs.
- Commercial incandescent operation.
- Consumers' installation expenses.
- Municipal street arc operation.
- Municipal street arc repairs.
- Municipal street incandescent operation.
- Municipal street incandescent repairs.

VI. Commercial expenses.
- Commercial administration—electric.
- Promotion expenses—electric.

VII. General and miscellaneous expenses.
- General officers and general office clerks.
- General office supplies and expenses.
- General law expenses.
- Miscellaneous general expenses.
- Insurance.
- Relief department and pensions.
- Electric franchise requirements.
- General amortization—electric.
- Electric expenses transferred—Cr.
- Joint operating expense—Cr.
- Accidents and damages.
- Law expenses connected with damages.
- General stationery and printing.
- Store and stable expenses.
- Undistributed adjustments—balance.
- Duplicate electric charges—Cr.

SECOND CONDENSATION OF OPERATING EXPENSE ACCOUNTS

For Corporations with Gross Operating Revenues from Electric Operations of Less Than $100,000 a Year.

I. Production expenses.
- Station superintendence and labor.
- Fuel for power.
- Other station supplies and expenses.
- Repairs of power plant buildings.
- Repairs of steam equipment.
- Repairs of hydraulic power plant.
- Repairs of gas power equipment.
- Repairs of power plant electric equipment.
- Miscellaneous station repairs.
- Steam from other sources.
- Power gas from other sources.
- Electric energy from other sources.

II. Transmission expenses.
- Transmission subway rent.
- Transmission repairs.
- Sub-station labor, supplies and expenses.
- Repairs of sub-station buildings.
- Repairs of sub-station equipment.

III. Electric storage expenses.
- Electric storage expenses.

IV. Distribution expenses.
- Electric distribution office and superintendence.
- Setting and removing meters and transformers.
- Distribution subway rent.
- Repairs of distribution mains.
- Repairs of electric services.
- Repairs of transformers.
- Electric meter operation and repairs.

V. Utilization expenses.
- Commercial arc operation.
- Commercial arc repairs.
- Commercial incandescent operation.
- Consumers' installation expenses.
- Municipal street arc operation.
- Municipal street arc repairs.
- Municipal street incandescent operation.
- Municipal street incandescent repairs.

VI. Commercial expenses.
- Commercial administration—electric.
- Promotion expenses—electric.

VII. General and miscellaneous expenses.
- General administration.
- Insurance.
- Relief department and pensions.
- Electric franchise requirements.
- General amortization—electric.
- Injuries to persons and property.
- General stationery and printing.
- Store and stable expenses.
- Miscellaneous adjustments—balance.

The primary accounts "joint facility rents" and "miscellaneous rent deductions," shown under "income deductions" in the scheme for corporations with gross operating revenues of $500,000 or over, are omitted in the first and second condensed schemes and in their place the account "other rent deductions" is substituted.

The third condensed scheme, for corporations with gross operating revenues from electric operations of less than $25,000 a year, differs from the classification of operating expenses in the second condensed scheme in the omission of the primary account "promotion expenses—electric" in the general account "commercial expenses." The third condensed scheme has a smaller number of other accounts. The capital accounts are the same as for the corporations of the other classes. The operating revenue accounts omit the following primary accounts, which are contained in the other classifications: "rent of electric meters," "rent of electric appliances," "electric merchandise and jobbing revenue," "sale of by-products," "joint electric rent revenue," "break-down service," and "other miscellaneous electric revenue." In the place of these accounts provision is made for "miscellaneous electric revenue—commercial." The third condensed classification has but one account for "non-operating revenues" instead of the six for

which provision is made in the other classifications. It has but four accounts under "income deductions," as follows: "interest deductions," "rent deductions," "miscellaneous contractual deductions from income" and "amortization deductions." The following four of the "appropriation accounts," as contained in the amplified classifications, are omitted: amortization elsewhere unprovided for," "appropriations to reserves," "gifts to controlled corporations" and "other appropriations." The account "miscellaneous appropriations" is substituted.

New England Electrical Outlook for 1909.

By H. S. Knowlton.

The outlook in the New England electrical field for the year now opened is bright with promise of improved business conditions and a wider extension than ever before of electrical applications in all industrial and social activities. It has taken New England a long time to shake off the effects of the late business depression, although the shock of the 1907 disturbance was at no time as severe as in sections of the country less strong financially. It is generally felt in New England that while the improvement in business conditions has been devoid of spectacular features, it has been steady and conservative, leaving little to take back from week to week as new demands for industrial activity have developed. The central stations are in a strong position with the opening of the year, and a continuance of careful management is sure to find its reward in the next few months. Telephone traffic has also been excellent, and the electric railways felt the effects of the depression less than did many other lines of business, although suffering from the universal disease of high operating cost compared with the figures of a few years ago.

With the opening of January and the turning of faces toward the spring trade, the power business of the New England central station ought to show a healthy growth. Now is clearly the time for the solicitor to put in his best work in securing power contracts for the coming months. It is a wise company which will now give its soliciting department free rein for a while, and if the late depression in business has depleted the force, renewed confidence all along the line can be stimulated by the enlargement of this department in the interest of general prosperity. The small manufacturer whose plant has been running on half time on power generated by his own plant can now be approached with special advantage from the point of view of central-station service. It is probable in not a few cases that part of his machinery has been standing idle so long and with so little attention that to put it back in shape again will cost a considerable sum of money, and here is the opportunity to talk central-station power with impressive force.

The central stations of New England have, in common with others in all parts of the country, been closely occupied with lighting problems associated with the tungsten lamp for the past year or two. The success attained in this field has been noted in these columns from time to time, and there is no question that the gas companies have been hard pressed by the advent of the low candle-powered tungsten units. The days are beginning to lengthen, however, and while there will be little disposition to slacken up the campaign for more and better illumination, particularly in residential service, the time is riper for a thorough study of the power possibilities. This class of business means so much to the station load factor and subsequent economy of power production in the summer days, yet far ahead, that it is worth making a more determined effort to secure. There are yet cities in New England which are practically asleep from the standpoint of community power saturation.

The electric railways of New England are likely to need continued economical operation for a long time to come. In Massachusetts, in particular, the necessity of breaking away from the time-honored unit of fare of 5 cents has become clearly established in a number of important instances among the suburban lines, and in certain rural or smaller urban companies. The Railroad Commission has thus far taken a broad view of the fare problem, and seems disposed to protect the rights of capital, while requiring good service in return. The managers are almost universally anxious to give good service, and the public is gradually beginning to realize that good service cannot be given unless an adequate return is enjoyed on the investment. There is little chance of a material lowering in the cost of electric railway materials and labor costs at present. Investment in securities of this class will clearly be confined to projects of demonstrated worth during the next few months. It is probable that with the easier money market various interurban projects that have been temporarily eclipsed will assume new life, notably in the vicinity of Boston. One of the most important questions lately raised and bearing upon the cost of operation and possible returns during the near future is the rate of fare that will have to be charged, even on city systems, in cases where the companies are obliged to meet interest and sinking fund requirements on improvements of enormous expense. There is food for thought in the recent masterly paper of Mr. Jas. L. Richards before the Massachusetts Street Railway Association describing the effect of huge investments in tunnels and subways upon the Boston Elevated Railway Company's dividend rate. A tunnel costing over $7,000,000 per mile calls for an enormous 5-cent traffic before even the fixed charges upon it can be paid.

The outlook for further technical advance in public service corporation administration is attractive. Thanks to the exhaustive figures of operating cost now available, in Massachusetts particularly, the trend of the times toward the more economical production of service can be studied quantitatively. The choice of station motive powers is approaching a most interesting stage, with the advance of gas and oil-engine practice and the expansion of water-power developments. The widening interest in forest preservation in New England is encouraging, and it is to be hoped that all possible pressure will be brought to bear upon Congress at the present session in behalf of the Appalachian Forest Preservation project. The progress of steam railroad electrification is likely to be stimulated more in New England in the coming year with the established success of the installations outside New York City and the gradual extension of the New Haven's electrical zone eastward.

Meeting of Toronto Section of the Institute.

The Toronto section of the Institute met for its regular monthly meeting on Dec. 18. The local membership was highly pleased with a visit from Mr. H. G. Stott, past president of the Institute, and superintendent of motive power, Interborough Rapid Transit Company, New York, who presented the paper for the evening, "Notes on the Cost of Power." Previous to the meeting 37 members enjoyed an informal luncheon at the St. Charles café with Mr. Stott as their guest.

The meeting proved the most interesting and successful since the inception of the local section. The attendance numbered 114, including 80 members of the Institute, 34 visitors from other local engineering societies being present.

Mr. Stott dealt very fully with the subject of his paper. Complete curves were presented, showing the relation between load factor and fixed charges for different plant costs; the cost of power per kw-hour and per kilowatt rated capacity at all percentages of rated load for reciprocating steam plant, steam turbine plant, reciprocating and low-pressure steam plant, gas-engine plant, gas-engine and steam-turbine plant and by hydraulic turbine plant. Typical summer and winter railway load curves were then shown, together with typical winter and summer lighting load curves and typical industrial curves, which were followed by a series of curves showing the variation in the total cost of power during the day for each of the several plants previously discussed when operating with the various typical loads.

The total cost of power and the operating cost of power for the various plants were also graphically shown. The subject

matter of the paper proper, in connection with these curves, proved intensely interesting and resulted in a long discussion in which, among others, the following participated: W. N. Ryerson, Dean Galbraith, Prof. Thos. R. Roseburgh, C. H. Mitchell, P. W. Sothman, X. L. Aitken, R. G. Black, Wm. G. Angus, W. A. Bucke, Edward Richards, A. L. Mudge, H. W. Price, H. F. S. Strickland, H. E. M. Kensit and W. A. Hare.

Effect of Drought in North-Eastern New York.

Mr. Harry C. Gray, manager of the Consolidated Electric Company, of Greenwich, N. Y., sends the following information as to the effect of the recent drought on the power conditions of his plant:

"The water flow in this vicinity is the lowest in the history of our oldest inhabitants. The stream on which we operate, the Battenkill, is a tributary of the Hudson River and rises in the Green Mountains, in Vermont. The headwaters are well timbered and for that reason the flow has held up better than in many other streams. Records covering ordinary years show an average of 212 cu. ft. per second for the dryest month and for the month of greatest flow, 243 cu. ft. A careful record kept for the month of October last shows the average flow to have been 73.9 cu. ft. per second, or about one-third of what this stream has been credited with heretofore for the dryest month of the year. The plant has a good storage, and with a head of 54 ft., service has been kept up without interruption. It may be added that no water has run over the crest of the dam since July 1. The months of November and December are even slightly worse than October."

Data on Chicago Electric Railway Rehabilitation.

At the noonday meeting of the Chicago Electric Club, held on Dec. 30, 1908, Mr. Ralph H. Rice, who is associated with the Chicago Traction Board of Supervising Engineers, gave some interesting data on the work of rehabilitation of the Chicago City Railway, the Chicago Railways and the Calumet & South Chicago Railway properties. The Board of Supervising Engineers acts in a general way as consulting engineers for these three railway companies. Mr. Rice gave some very interesting data in relation to the work that has been accomplished by these railways since the ordinance which placed these properties under the supervision of the board was granted. He stated that during the 18 months the ordinances have been in force, approximately $25,000,000 has been spent in the rehabilitation of the properties. At the close of the address several of the members of the club questioned the speaker closely in relation to the probable life of the track construction that is being installed on these several properties. In response, Mr. Rice stated that in his opinion electrically-welded rails are not weakened from the heat applied at the time the weld is made. In a few instances changes of temperature in the atmosphere have caused breaks to appear in the welded rails, but he said that without exception, so far as he was aware, the breaks occurred at points located some distance from the welded joint. As a usual thing the break appeared at a point just beyond the part of the rail that was heated during the welding process.

The noonday meetings of the Electric Club have proved so valuable and have brought out so many interesting talks and discussions that it was voted that the club should engage a stenographer to report all of the meetings and that a stenographic report be furnished to each member of the club. It is expected that much good will come from thus recording and distributing the minutes of the meeting, as in nearly every instance the speakers at the weekly meetings are men of prominence, and without exception they divulge data that are extremely interesting to men engaged in any of the branches of the electrical industry.

CURRENT NEWS AND NOTES.

RUBBER.—An interesting article on rubber and its "relatives" appears in the December issue of the bulletin of the International Bureau of American Republics, and the magazine contains also a great rarity of other very interesting matter.

CHINESE MAGNETIC SURVEY.—It is reported from China that a magnetic survey is to be made of that country and that Dr. Edwards, of the Carnegie Institution, Washington, who is to carry it out, has been at Shanghai preparing for it.

COAL CONSUMPTION IN GENERATING STATION.—In a paper read by Mr. F. H. Corson before the (British) Institution of Civil Engineers, on Dec. 22, it was stated that recent tests of coal consumption in 34 principal generating stations in the United Kingdom showed values ranging from 3.6 lb. to 15 lb. per kw-hour, the average being 7.7 lb.

TROLLEYS IN JAPAN.—According to recent advices from Japan, the Osaka-Takaradzuka electric railway of 15½ miles and the Minomo-Arima branch of 2½ miles will be constructed at a cost of $1,437,500. A loan of $650,000 has been arranged with English capitalists, at the rate of 7.9 per cent. It is understood that the parties furnishing the capital have secured the contract for installing the plant.

CHEMICAL ENGINEERS.—The American Institute of Chemical Engineers had its first annual convention in Pittsburgh last week. It has already over 100 members. The following officers have been elected: President, Samuel P. Sadtler, Philadelphia; vice-presidents, Charles F. McKenna, New York; H. A. Hunicke, St. Louis, and Edward G. Acheson, Niagara Falls, N. Y.; secretary, John C. Olsen, Brooklyn; treasurer, William A. Booth, Syracuse, N. Y.; auditor, Richard K. Meade, Nazareth, Pa.

ENGINEERING EDUCATION.—With regard to the recent discussion in these pages on the subject of giving greater breadth to engineering education, a reader sends us the following example of breadth, but not necessarily of depth: "I was graduated from . . . University last June in the electrical engineering course. Before entering, however, I mastered the typesetting branch of the printer's trade. Hence this application for work in the publication department of your company. I believe that with my technical knowledge and wide experience at the printer's trade I am qualified to fill a position in the publication department."

CONTROL OF CORPORATIONS.—It is stated with some apparent degree of authority that President-elect Taft is working out the details of a plan designed to increase the efficiency of government regulation of corporations doing an interstate business. The proposed plan will need legislation from Congress decreasing the powers of the Interstate Commerce Commission, greatly increasing the powers of the Bureau of Corporations in the Department of Commerce and Labor and creating a practically new bureau in the Department of Justice. The Interstate Commerce Commission is to be relieved of its duties as an investigating body and will enjoy only quasi-judicial functions. The jurisdiction of the Bureau of Corporations, on the other hand, is to be extended over all corporations doing an interstate business. It will take up the detailed work of investigating and preparing cases. This bureau, acting upon individual complaints or upon its own initiative, will lay the results of its investigations before the Interstate Commerce Commission for decision. It will originate all cases. The new bureau in the Department of Justice will work in co-operation with the Bureau of Corporations and the Interstate Commerce Commission when legal aid is necessary. It is said that the proposed plan does not contemplate the licensing of corporations, but that under it corporations will probably be obliged to submit to closer scrutiny by the Bureau of Corporations.

CHICAGO STREET LIGHTING.—Mr. William Carroll, city electrician of Chicago, in his annual report for 1908, says that great reduction in the cost of electric street lighting has been effected by utilization of the power obtained from the Chicago Drainage Canal. Two new distributing stations for adapting this current to the requirements of the arc-lighting circuits have been erected during the year. There are now 9452 street arc lamps in service, while 2911 others are nearly ready for use.

CHICAGO NIGHT COURSES OF ELECTRICAL ENGINEERING.—Lewis Institute, Chicago, Ill., began on Monday, Jan. 4, 1909, giving evening courses of instruction in electrical engineering, the winter term to continue for 10 weeks. The classes will be conducted from 6 o'clock to 10 o'clock on Monday, Tuesday, Wednesday and Thursday evenings. The courses announced for the first, second, third and fourth years, respectively, are engineering principles of electricity, direct-current motor and generator testing, alternating-current transformers and transmission, and alternating currents.

AUSTRALIAN WATER POWERS.—In a recent interesting paper before the engineering section of the Royal Society of New South Wales, Mr. E. Kilburn Scott summarized data as to hydro-electric development in Australia. The continent is singularly lacking in natural water powers, but offers many excellent opportunities for reservoiring. He gave details of a scheme for Trawood, on the Goulburn River, with a dam 1800 ft. long and 180 ft. high impounding over 60,000,000,000 cu. ft. of water, generating 10,000 hp continuously, and 20,000 hp for six months in the year. He stated that the Barron Falls, still undeveloped, would yield 3800 electrical horse-power at the generator terminals the year around, and 5000 hp with water storage. He gave a table of three developments totaling 4850 hp, one each in Tasmania, New Zealand and New South Wales. The longest transmission is 19½ miles; the highest pressure 35,000 volts.

ANNUAL UNDERWRITERS' MEETING.—Mr. C. W. Goddard, secretary of the Underwriters' National Electric Association, states that the annual meeting of the Electrical Committee of this association will be held in March, 1909, in New York City. The day and place of the meeting will be announced later. As usual, the provisions of the National Electrical Code as they now exist will be the principal matter for consideration, and it is requested that any desired changes in, or additions to, the code, be forwarded to him in Boston on or before Feb. 1, 1909, in order that they may be printed in the bulletin, and the committee and other interested parties may thus have opportunity to consider them in advance of the meeting. Final action on suggestions not received in season for consideration by the committee before the meeting can only be taken by unanimous consent. The meeting will be open to all interested, who will not only be welcome, but are urged to be present and give the committee the advantage of their experience and advice.

TELEPHONE POLITENESS.—A recent circular of the British postoffice contains a long notice with heads for standard expressions to be used by telephone operators engaged on trunk work. It says: "In order that abrupt and uncouth expressions may be avoided in the telephone service, telephonists engaged at trunk exchanges are in the future to make use of the following expressions in connection with their work, and the supervising officers should impress upon the staff generally the necessity of adhering to the authorized form of words." Entering into details this official guide lays stress upon the advisability of using the word "please" where it can conveniently be introduced. "The telephonist answering a call should announce her presence by saying: 'Trunk number, please?' Failing to hear what the subscriber says, she should say: 'What is your number, please?' and so on. "When a subscriber's attention has been obtained for the trunk call the telephonist should say: 'What is your number, please?' If the subscriber should be kept waiting for more than the regulation time the telephonist should add: 'Sorry to have kept you waiting.'"

ELECTROLYSIS DEFINED.—In a letter to the Rochester (N. Y.) *Democrat and Chronicle*, one E. H. Terhune calls attention to the "disastrous results, constantly augmenting in their scope and evil nature, that are being brought about through the increasing use of the force of nature in the shape of electricity." Warning the reader that "No one but a fool closes his ears to words of wisdom," and after incidentally referring to the danger to the stomach and respiratory organs from the nitric acid produced by high-tension wire, the following chunk of wisdom is presented: "No one can possibly dispute the fact that all of the accumulated force that is distributed on wires throughout the world is depreciating the capacity and the adjustment of nature just that much. Nature's force, ordinarily obedient to a general law, promotive of good, thus becomes abnormally distributed; it is taken from the air or the earth, as the case may be, in one place; a proportion is constantly going back to the earth in many places. Distributed in this way, it produces a condition which we call 'electrolysis.'"

LIGHTING AT RICHMOND, VA.—There was a severe storm recently at Richmond, Va., when the city authorities ordered the cessation of the lighting service, for the safety of the citizens. Mr. George H. Whitfield, the general superintendent for light and power of the Virginia Passenger & Power Company, writes us as follows in regard to the incident: "We experienced a very unusual snow storm in which the snow was wet and heavy and clung to the wires, weighting them down just as sleet would do. The result was that the telephone and telegraph companies suffered very great loss by the breaking of wires and poles. We had only one wire and one pole broken, but the crossing of our wires by the telegraph and telephone wires was so extensive that the city authorities considered it would be more dangerous to life and property to turn on the street arcs than to be without them, and accordingly ordered that they should not be turned on. Of course we had our linemen working day and night clearing up our lines; and the result was that at the time when the papers reported that the city was in utter darkness, we were supplying every one of our customers in the city and suburbs, except the city itself. This fact was pointed out to the newspaper people, but they preferred not to spoil a good story by changing it."

ACCIDENTS IN INDUSTRY.—A bulletin of the Bureau of Labor, by Mr. F. L. Hoffman, gives some startling figures as to the severe accident liability of workmen in the United States. The number of lives lost in a year by accidents to employees while at work is between 30,000 and 35,000. Census reports covering the years 1900 to 1906 show that out of over 1,000,000 deaths of males, more than 9 per cent were due to accident. A large proportion of these deaths are due to causes related to the occupations of the injured persons. The report takes up these accidents in five groups, viz., factories and workshops, electrical industries, mines and quarries, transportation by rail and transportation by water. Of those employed in factories and workshops probably the most exposed class are the workers in iron and steel. Reports of 8456 accidents to this class of workmen for the years 1901 to 1905 show that 4.1 per cent of the accidents to men employed in rolling mills were fatal. Among nut and bolt workers in Pennsylvania the returns of the chief factory inspector show the fatal accident rate during 10 years to have been 5.4 per 1000, and in miscellaneous steel and iron work 4.3 per 1000. According to the industrial insurance returns and data, the fatal accident rate of electricians and of electric linemen is excessive. Of 645 deaths of electricians 14.7 per cent and of 240 deaths of linemen 46.7 per cent were due to "accident." Even conceding frequent carelessness and contributory negligence, the waste of human life is serious if regarded merely from the economic standpoint.

A Recent Swedish Hydro-Electric Plant.

By P. FRENELL.

IN the south of Sweden two large water-power developments have recently been planned. One, owned by the South Swedish Power Company (Sydsvenska Kraftaktiebolaget), has its area of distribution in the southwestern part of Sweden,

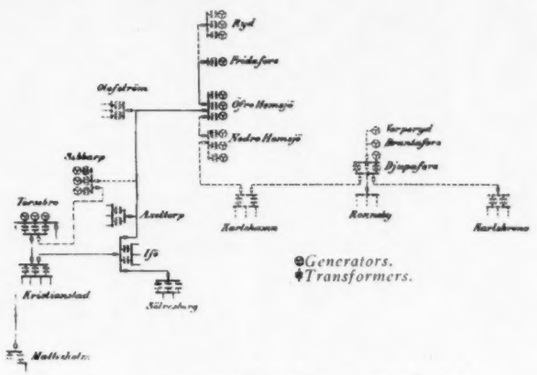


FIG. 1.—INTERCONNECTIONS OF STATIONS.

especially in the towns of Malmö, Helsingborg, etc., and the other, owned by the Hemsjö Power Company (Hemsjö Kraftaktiebolag), distributes its energy in the southeastern part of the country, the principal towns being Kristianstad, Sölvesborg, Karlshamn and Karlskrona. The equipment of the first of these two companies is not yet in operation, as the power stations, transmission lines and transformer stations will not be completed until the latter part of 1909. The latter, however, has been in daily operation since the beginning of 1908. As this plant represents the latest electrical developments in Sweden, a description of its features might be of some interest.

The map, Fig. 2, shows the hydrographical situation of the district in which the company operates. In the district are three rivers: the Helge, the discharge for Lake Möckeln; the Mörrum for Asnen and Ronneby for Lake Rottnen.

All these rivers have many falls, of which the largest ones belong to the power company and are as follows:

Torsebro waterfall in the Helge	3000 hp
Ryd (two falls) in the Mörrum	4000 hp
The Upper Hemsjöfall in the Mörrum	3500 hp
The Lower Hemsjöfall in the Mörrum	2800 hp
Verperyd, Brantafors, Djupafors in the Ronneby	3500 hp
Sibbarp in the Blistorp Brook	5000 hp

It is now 10 years since the work at the waterfalls in the River Mörrum, the Hemsjö Fall, began.

An open canal, about a mile in length, was dug and the power station building erected, intended to contain four turbo-generator sets with the necessary raising transformers and switching apparatus.

While these works were going on a conflict arose with the owners of the fishing rights in the Mörrum River, the fishing proprietors being of the opinion that the power plant would interfere with the fish on account of the water passing through the turbines. The conflict did not come to an end before the year 1905, and consequently no energy could be delivered until that time. In the next year the Hemsjö Power Company was organized, the object of the company being to supply energy to the towns of Kristianstad and Sölvesborg and to the cement mills at Maltesholm and Ifö. The total consumption is about 3000 hp, which is just the amount the power station at Hemsjö can deliver during eight or nine months of the year. During the other months, however, the same power cannot be got as the regulation of Lake Asnen has not yet been accomplished.

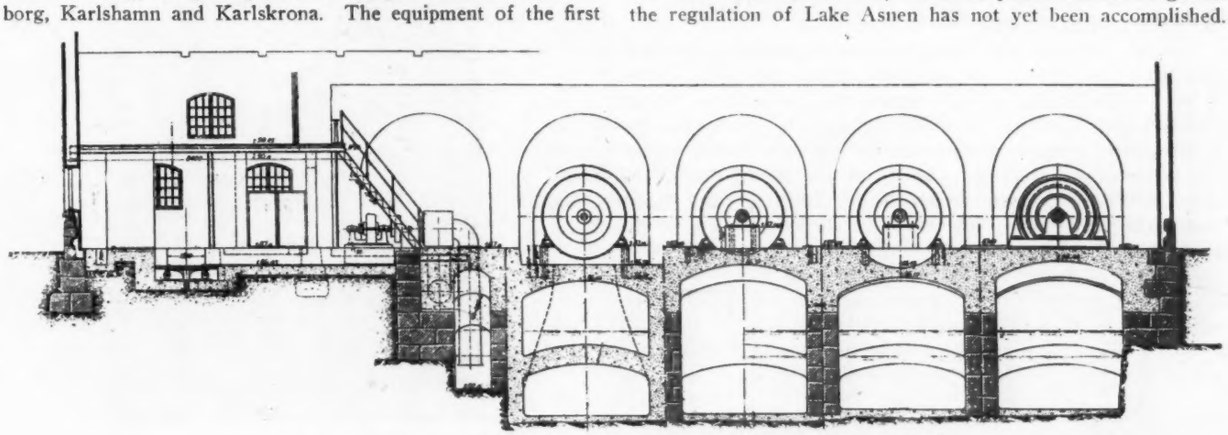


FIG. 3.—SECTIONAL ELEVATION OF GENERATING STATION AT UPPER HEMSJÖ.

To enable the company to fulfill its contracts with the consumers special agreements were made that when there was a scarcity of water the company should have the privilege of using the consumers' steam and gas machines that had become superfluous through the electrification. By this arrangement the company has obtained a reserve supply of 1500 hp.

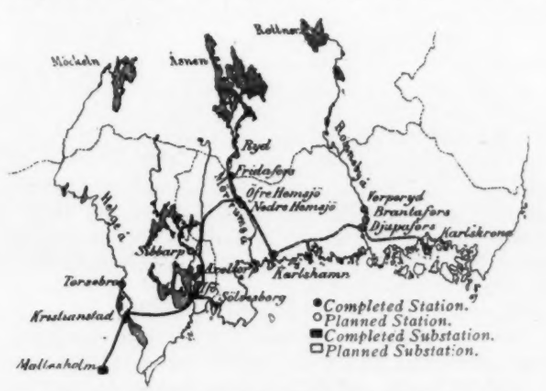


FIG. 2.—MAP OF DISTRICT IN WHICH COMPANY OPERATES.

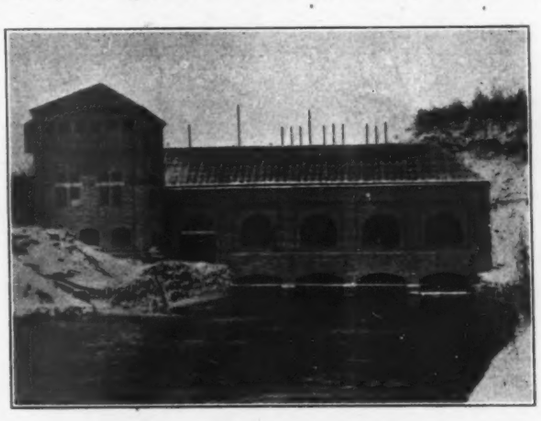


FIG. 4.—EXTERIOR OF POWER STATION AT UPPER HEMSJÖ.

OUTLINE OF THE SYSTEM.

In the diagram, Fig. 1, may be seen the completed parts—drawn in full lines—as well as the future ones which have been marked in dotted lines. The power station at Torsebro, with a transmission line to Kristianstad, is also shown here in full lines, being under erection and expected to be completed in

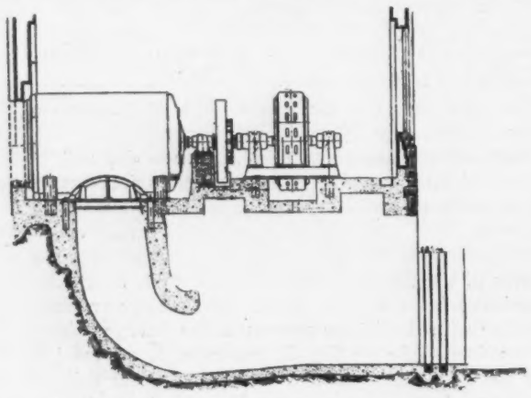


FIG. 5.—CROSS-SECTION OF GENERATOR ROOM.

the near future. The amount of power at present at the command of the Hemsjö Company is about 20,000 hp.

Transformer stations have been built at Axeltorp, Ifö, Sölvesborg, Kristianstad and Maltesholm. In the future there will also be transformer stations at Karlshamn, Djupafors for Ronneby, and Karlskrona.

Of the waterfalls above mentioned those situated at the Mörrum River have a variable quantity of water. In order to get a more constant flow of water Lake Asnen is to be regulated. Under the present state of things the amount of water in the Mörrum River decreases to 10 cu. m per second during four or five months, but keeps at 20 cu. m per second during the other months of the year. After the regulation of Lake Asnen one might count upon at least 20 cu. m all the year round. On calculating the effect of the Upper Hemsjö power station a water flow of 20 cu. m has been taken as a basis. The fall is 50 ft. Consequently the total amounts to 3000 hp. Three 1000-hp units have been installed.

At the Ronneby River the regulation of Lake Rottnen has lately been consented to by the Swedish government, so that

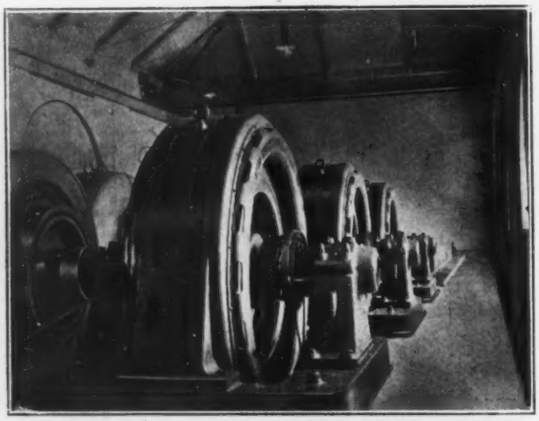


FIG. 6.—INTERIOR OF STATION AT UPPER HEMSJÖ.

a constant waterflow of about 3500 electrical hp throughout the year has been obtained for the power stations at Djupafors, Brantafors and Verperyd. When water is lacking the company has made an agreement with the Fridafors Company to receive 400 hp from a power station some five miles north of Hemsjö. These two power stations are, therefore, working in parallel, being connected with each other by means of a 40,000-volt transmission line. The energy is delivered on the busbars at Hemsjö.

In Fig. 2 are shown the transmission lines between the different places mentioned above. All of the lines are insulated for 40,000 volts.

At Axeltorp a transformer station has been erected for the kaolin works at that place. The consumption is about 200 hp for motors and lamps.

At Ifö another transformer station has been erected for the cement and kaolin works. The consumption is from 1000 to 1200 hp. From this station a line branches off to Sölvesborg.

In Kristianstad the greater part of the power is being used for private industries and some of it for municipal electricity and water works. On account of the shape of the town being long and narrow and of the great distances between the consumers, a double transformation has been necessary. The primary station transforms from 40,000 volts down to 5000 volts and the secondary stations from 5000 to 500 volts. The primary and secondary stations are connected by cables.

At Maltesholm, the rating of the transformer station is the same as that of Ifö. In Sölvesborg the electric energy is chiefly used for lamps, there being no motor users of any importance. A double transformation has also been necessary. The secondary e.m.f. in the primary station is 1750 volts, the e.m.f.

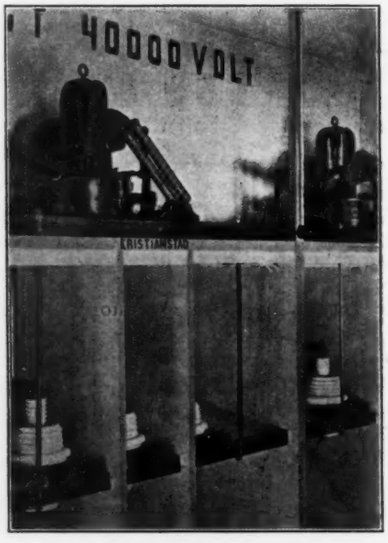


FIG. 7.—OIL SWITCHES.

being reduced to 220 in two secondary stations, which are connected with the primary through a cable for one of them and through an overhead line for the other one. The lighting distribution system is being fed with energy at the latter distribution. The lamps, being connected between the neutral and outer conductors, are subjected to an e.m.f. of 125 volts, which is suitable for the new types of incandescent lamps.

THE UPPER HEMSJÖ POWER STATION.

As mentioned above, the dam and the canal for the station were constructed some years ago. The water is led through a long canal to the station. The dam is built for four steel tubes, each one connected to a turbine with a horizontal shaft. The internal diameter of the tube is 2300 mm and the thickness is 6 mm. At each of the tube entrances hand-operated ice-gates and sluices are arranged in the usual way.

In the power station, the exterior of which is shown in Fig. 4, there are placed three turbines giving a little more than 1000 hp at a fall of 14.5 m. The speed is 300 r.p.m. The turbines have double wheels and are directly connected to their respective generators by means of flexible-leather couplings, which are combined with flywheels as the moment of inertia of the rotating parts of generator was found to be insufficient. In addition to the large turbines in the power station there are also two small 80-hp turbines, each one directly connected to a di-

rect-current exciter generator. The 1000-hp turbines have hydraulic generators of the servo-motor type. The inlet for the smaller turbines can be regulated by hand from the instrument balcony; there is also a common automatic regulator which, by means of a belt, can be connected to either of the two turbines. Consulting engineers for the hydraulic parts of the power station, including the dams, canal, tubes and water turbines, have been Aktiebolaget Vattenbyggnadsbyran, Stockholm. The tubes, turbines and regulators with accessories were manufactured by the Karlstad Mechanical Works.

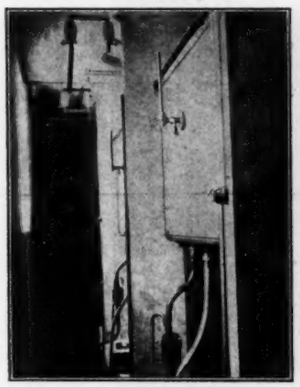


FIG. 8.—WATER INLET AND OUTLET OF TRANSFORMER.

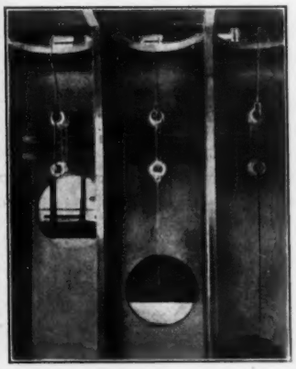


FIG. 9.—DISCONNECTING SWITCHES.

The electrical equipment of the power station consists of three three-phase, 900-kva generators (Fig. 6). The generator e.m.f. is 3800 volts at a frequency of 50 cycles per second. The efficiency of the machines is 92.8 per cent at a power factor of 0.75 and 900 kva output, and 93.8 per cent at unit power factor and 675 kw output. Both values are based on the inclusion of the losses in the generator-field circuits and in the rheostat. The regulation of the generators between normal full-load and no-load amounts to 21.6 per cent at a power factor of 0.75 and to 7.9 per cent at 1.00 power factor.

Each of the step-up transformers in the station is directly connected to its corresponding generator without any intervening busbars. The conductors between them consist of 3 sq. mm x 70 sq. mm lead-clad and ironclad three-phase cables, laid into channels in the floor. The transformers which increase the e.m.f. from 3800 to 40,000 volts are of the three-phase type, oil-

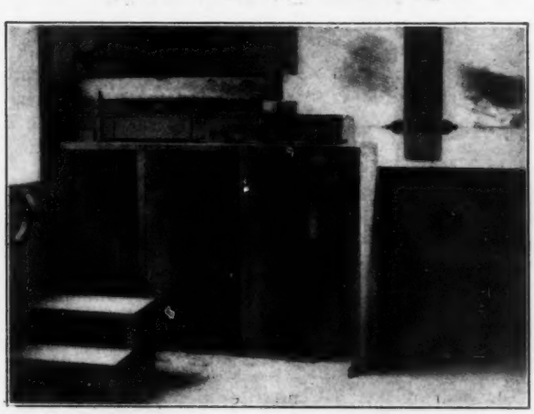


FIG. 10.—WATER-JET APPARATUS.

insulated and water cooled. The cooling water is drawn from the canal above the station through a branch-off piping. Fig. 8 shows the water inlet and outlet on the transformers. In the outlet is an automatic device which gives a signal to the switchboard attendant in case the water should stop running. This device consists of a lever with its fulcrum in the center. At one end of the lever there is a cup over which the water runs from the transformer before getting into the final outlet. Below the other end of the lever there is an electric contact. When this contact is closed a signal is given to the attendant by means of an ordinary bell. The contact is closed by gravity by the lever as soon as the water pressure on the cup from the running water is diminished or stops altogether. Inside the transformers there are tubes shaped into spirals through which

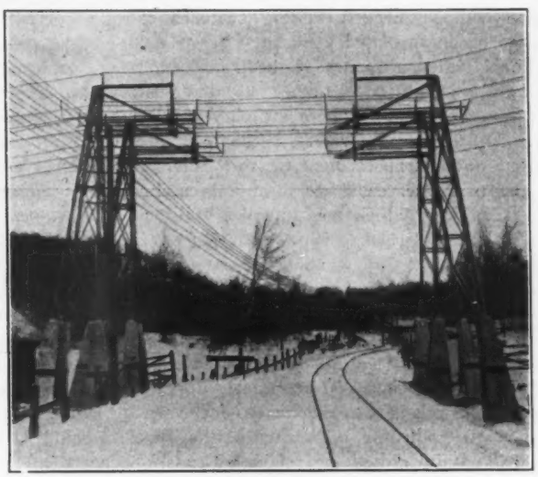


FIG. 11.—RAILROAD CROSSING.

the water passes. The oil tank is very strongly constructed of boiler-plate and angle bars. In addition to the above-mentioned signal device each transformer is provided with a dial thermometer so that the temperature of the oil can be observed from a distance. In Fig. 8 are also shown the signal device, the oil stand and the disconnecting switches to the neutral. The transformers are placed on wheels and rails for facilitating the making of repairs. The transformers are by these occasionally removed from their places with a small truck which can be moved alongside them out to the generator room. The purpose of this arrangement is to use the same crane for the repairs of both the transformers and the turbines and generators.

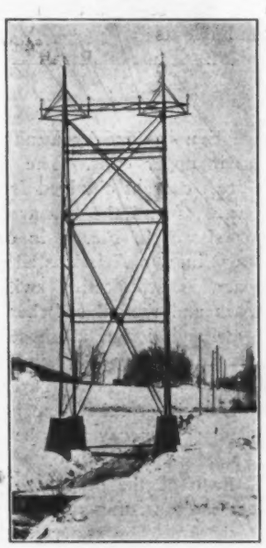


FIG. 12.—IRON POLE.

Between the generators and transformers, oil fuses are inserted in order to protect the generators against short-circuits in the cables leading to the transformers. To render a shut-down at ordinary overloads impossible these fuses are rated at 100 per cent above the normal current.

Before proceeding to a detailed description of the high-tension switchgear a few words may be said about the fundamental principles which have been applied in its design. The switchgear is so arranged that each integral part of it can be disconnected and repaired whenever necessary without causing the least interruption in the normal service. This principle has been followed throughout with the exception of the high-tension busbars, of which there are no duplicates. The cause of this exception was that two sets of high-tension busbars would have demanded too much room in the building and therefore caused unnecessary expense. Another reason for adopting single busbars was the character of the system of installation used. The busbars are erected on specially designed insulators, separated by fireproof walls. For these reasons

there are almost no possibilities for a short-circuit or breakdown on the busbars.

The disconnection of the different parts is made possible by oil switches in conjunction with disconnecting switches. An oil switch can break a very large amount of power, but this apparatus requires considerable inspection and repair. For this purpose use is made of ordinary knife-type disconnecting switches, which are so simple and solid in their design that no repair will be needed. These switches can be operated by means of an insulated hook.

The high-tension sides of the transformers are connected to busbars through oil switches situated just above the transformers. (Fig. 7.) These switches are designed to open the circuit of two transformers, because in case of a short-circuit on one of the transformers the two others deliver their energy to the first one. The switches are equipped with automatic reverse power, which are adjusted to break at a 25 per cent reversal. The relays, which are placed behind the switchboard, receive their operating current from series transformers connected to the leads between the main transformers and the busbars, and they receive the necessary e.m.f. from three-phase shunt transformers connected through fuses to the busbars. The operating current for the oil-switches is supplied from a direct-current source. In addition to disconnecting for reverse-current the relays also disconnect for overload. Each lead is opened twice in the oil switches, the rupture being accomplished within closed porcelain oil-cans. Contact and disruption is done by means of metal rods electrically joined at their upper ends. The switches are operated electrically by direct current obtained from the exciter circuits. Between the switches and the busbars disconnecting switches are inserted, as shown in Fig. 9, in order to make repairs possible. The two lines to Kristianstad and Fridafors tap off from the busbars. Disconnecting switches are inserted between the busbars and the oil switches. The oil switches are of the same type and design as those described above. The one for the line to Kristianstad, however, is automatic for overload and the one to Fridafors for reverse power. On account of an agreement between the Hemsjö Power Company and the Fridafors Company energy is to be delivered only in the direction from Fridafors to Hemsjö.

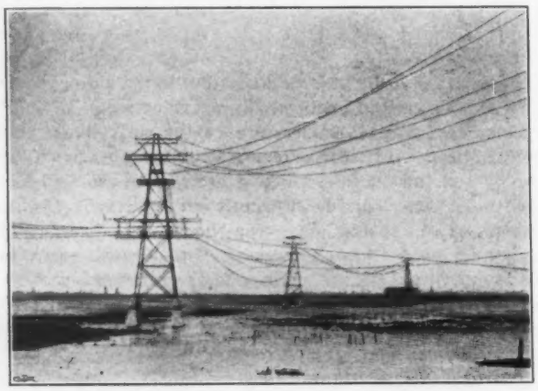


FIG. 13.—IRON POLE AT TELEPHONE CROSSING.

Each of the outgoing lines is protected with lightning arresters consisting of horn gaps connected in series with water resistors. The water in the resistors is arranged circulating.

The static electricity on the lines is discharged through a water-jet apparatus connected to the busbars through disconnecting switches. The apparatus is illustrated in Fig. 10. Choking coils are inserted to prevent high-frequency currents from entering the transformers.

The lines pass through the walls of the building by way of two glass squares which support a glass tube through which the conductor passes.

In case of a short-circuit to ground on the lines there might be produced a dangerous current. To limit the current to a safe value the neutral on the high-tension side is not directly grounded, but instead there has been placed between the neutral and the ground a resistor calculated to withstand from 2.5 to 3.0 times the normal current on each transformer for 10 seconds, during which time the automatic switches will open.

FIG. 14.—CARRIAGE FOR REACHING IRON POLES.

In the power station each one of the high-tension conductors is separated from the others by fireproof concrete walls. This method has been recommended as the safest both from the electrical and the operating point of view. To allow the concrete walls to be as thin as possible yet strong they are built upon a skeleton of iron wire which is fastened to the stem flange of a T-iron. The iron limits the walls toward the passages and is therefore turned with its foot flange outward. The distance between any high-tension conductor and these walls or any other grounded parts is never less than 250 mm, but is in general somewhat larger.

In order to protect the attendants inside the station against every danger from high potentials, all iron parts, such as the turbine frames and generator frames, the iron skeleton of the building and all iron required for high-tension and low-tension apparatus are connected together and grounded. Thus all the T-irons for the fireproof walls are grounded. By this precaution no danger to life arises from any weakness of the insulation.

The switchboard consists of nine marble panels mounted on an iron structure, one panel being for the two exciters, one for each of the three generators, one blank panel for a future generator, one panel for the synchronizing apparatus, and three panels for outgoing lines. There are two push-buttons for the turbine regulator, used when synchronizing the generators. On the turbine regulator there is placed a small direct-current series motor acting on the regulator's handle by means of a worm wheel. By pushing one of the buttons the motor is rotating in a certain direction and by pushing the other one the motor is rotating in the reverse direction.

It has already been mentioned that Sölvesborg gets energy for lamps directly from the three-phase system. On account of the large amount of power distributed to other places so great variations in voltage would have arisen that the light in the town would have suffered had no special precautions been

FIG. 15.—DYNAMOMETER FOR STRETCHING WIRE.

taken. In order to get as constant a voltage as possible an automatic Thury regulator has been installed at Hemsjö. This regulator, which is driven by a small direct-current motor, actuates a pinion rod which operates the field rheostats by means of pinions. Thus the three field rheostats are operated simultaneously so that the voltage of the three generators vary simultaneously. The operation of the regulator is accomplished by means of a shunt coil connected to the secondaries of the potential transformers for the outgoing line to Kristianstad. The potential drop of 6.5 per cent between Hemsjö and Ifö, where the line to Sölvesborg branches off, is compensated for in the regulator circuits.

The energy for lighting the power station is obtained from a three-phase transformer connected to one of the generators. This transformer can be connected to either of the two generators by means of a double-throw switch. The lighting of the machine room is accomplished chiefly by means of arc lamps.

THE TRANSMISSION LINE.

The transmission line between Hemsjö and Fridafors consists of three 16-sq. mm wires, between Hemsjö and Kristianstad of three 25-sq. mm wires, and on the lines Kristianstad-Maltesholm and Ifö Sölvesborg of three 16-sq. mm wires, all wires being of hard-drawn copper. The conductors are arranged in an equilateral triangle with 1250 mm (4 ft.) sides and mounted on insulators of the Rörstrand type. The insulators are supported by wrought-iron arms 1 in. in diameter. Each arm is fastened to the wooden pole by means of ⅝-in. wood screws, and can withstand a force of 220 lb. at its outer end without being permanently deformed. The arms are carried on pine poles 40 m (44 yd.) apart. The poles are from 7 in. to 8 in. in diameter at the top, and the height over the ground is from 28 ft. to 30 ft. and they are from 5 ft. to 7 ft. in the ground. The poles are not impregnated. In order to obtain equal induction in the three conductors they are transposed, a full transposition being achieved on 90 poles in 6 steps.

The line is protected against lightning by horn arresters placed at 10-km intervals. The gap on these arresters is slightly less than the flashing surface of the insulators, being set at 5 in. The purpose has been to establish a few weak points along the line through which the transient charge will pass when lightning, which is very common in this district of the country, occurs.

The total length of the transmission line is 95.6 km (60 miles). There are railway crossings at 10 places, a typical crossing being shown in Fig. 11. A steel tower is placed on each side of the railway with overhanging bridges. The distance between these bridges is so chosen that if a wire gets broken the ends of it do not come in contact with the train. In order to standardize these crossings as far as possible and yet to suit the different profiles of the railroads the iron towers are made in three different lengths and their foundations go more or less deep into the ground. The towers rest on four legs, which consist of the extended iron structure clad with concrete. The concrete is drawn up to about 5 ft. above the rails. This arrangement has the advantage that persons and animals will be protected from shocks from any high potential produced when one of the high-tension conductors comes in contact with the iron structure. These potentials will always occur unless the resistance to ground is very low. It is well known that the concrete is an insulating material, although not a very good one, when dry. Even in rain that part of the concrete which is always above the ground is a fairly good insulator. All of the crossings are grounded by copper plates sunk into the earth. It has been found by measurements that the iron towers themselves have in general a lower resistance than the copper plates.

There are a great many high-road and telephone crossings which, in acordance with the Swedish law, must be provided with ground connections. At many crossings it has been very difficult to find places where the ground resistance could be kept down to the limit given by the government—namely, 200 ohm.

On account of the line crossing agricultural country between the railway station and the power station at Hemsjö iron poles have been put up for a distance of about 700 m (750 yd.). The lines to Kristianstad and Fridafors have been put on common poles. The pole construction is shown in Fig. 12. Four iron poles are spaced 200 m apart. Two of these poles, called strain poles, have been designed not only to take strains sideways, but also in the direction of the line. The two intervening poles are arranged for taking strains sideways in the direction of the line only. The spacing between the conductors on these poles is 2.0 m (6 ft. 8 in.). As there is a road crossing at the place illustrated hard-drawn copper cable has been used for the conductors. The construction of this copper cable may be mentioned especially as it differs considerably from the ordinary design. It consists of six copper wires, the core wire being of hemp. By this arrangement all of the wires will be affected by the same strain. In ordinary cables with a wire core the center wire has to take up the greater part of the load and consequently has a tendency to pull apart, whereby the cable as a whole will be weakened in mechanical as well as in electrical respects.

At Kristianstad the line coming into the transformer station, as well as the one leaving, has had to be erected across swamps inundated during the greater part of the year. It was necessary therefore to use iron poles instead of wooden ones. Fig. 13 gives a view of the transmission line north of the transformer house. The poles have been designed for double lines, as the future line from the Torsebro power station is to be extended to the transformer station. All of the poles are of the strain type, as each one must take up the strain from the deviations of the line. Their general appearance differs also somewhat from those at Hemsjö.

The first pole shown in Fig. 13 is of special interest, as there is a telephone crossing at this place. The telephone wires have been run through the iron structure of the pole, the insulators being put on iron racks, which are insulated from the pole. This arrangement has been used in order to prevent the telephone wires from receiving tension from the pole in the event of a break or an insulation fault on the telephone wires. To protect the telephone wires against an occasional breakage on the high-tension conductors, guard irons have been placed on each side of the pole both above and beneath the wires. The guard irons extend beyond the utmost conductor and the upper pair have been bent upward to catch falling conductors. As the iron poles to the north and west of the transformer house at Kristianstad are inaccessible both by land and by water during the greater part of the year, a special steel cable for conveying persons and material has been erected below the conductors. A special kind of wagon has been constructed resembling a scale, in which the workmen pull themselves along as seen in Fig. 14.

To obtain the proper tension in the wires during erection, use was made of the special dynamometer shown in Fig. 15. The wire or the cable is fastened between two clamps. By means of links the upper one is connected to the foremost part of the apparatus, which part consists of a small drum round which the wire rope for stretching the conductor is wound. During stretching the wire rope is fastened with one end to the insulator pin or to the top of the insulator and with the other one to the drum. The drum is turned by a handle, a catch preventing its backward movement. On the side of the apparatus there is a hand for indicating the tension in kilograms. This little apparatus has proved very useful in simplifying the erection to a great extent. Its weight is only 3 kg and it is therefore easy to carry about and handle.

The anchorage of the transmission line to the transformer stations and to the generating stations has been accomplished in the following way: For each of the conductors two insulators have been put up in series with each other. These have first been joined at the tops with binding wires and then the line has been fastened by a loop to the outer insulator.

The loop hooks into the binding wire like links, so that in case of breakage in the outer insulator the line remains fastened to the inner insulator and hence does not fall to the ground. By this method the anchorage strain from the line is evenly divided on two insulators.

It might be of some interest to give a few data of the line. Since the line was completed impedance and no-load measurements were made on the section between Hemsjö and Kristianstad, whereby the following line constants referred to the kilometer as the unit of length were obtained.

Resistance = 0.6902 ohm.

Inductance = 1.1899×10^{-3} henry.

Isolation-resistance = 5.764 megohm.

Capacity = 0.010335×10^{-6} farad.

The measurements were made at a temperature of +2 deg. C. and the insulators were covered with snow in a thawing condition. The value of the isolation-resistance can therefore be considered as the lowest attainable.

SUBSTATIONS.

Primary transformer stations have been erected at Ifö, Maltesholm and Sölvesborg. The primary voltages for these stations have been calculated for the system at full load, due regard being taken to the series resistance and reactance of the lines and the shunted capacity. The different e.m.fs. amount

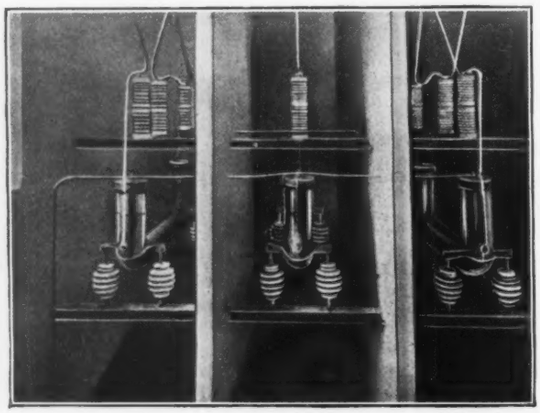


FIG. 16.—LIGHTNING-ARRESTER EQUIPMENT.

to 37,300 volts for Ifö, 36,700 for Kristianstad, 36,300 for Maltesholm, and 37,000 volts for Sölvesborg.

When selecting the units for the transformer stations one had to decide between either the single-phase or the three-phase type of the self-cooling, oil-insulated transformers, as the water-cooled transformer was out of question, there being no water at the places where the transformer stations are situated. On this account one was restricted to sizes not exceeding 500 kva, as this is about the largest economical rating for self-cooled transformers. If three-phase transformers had been selected two units would have been necessary and one spare unit would have been required for each of the stations at Ifö and Maltesholm. Hence, one-third of the transformer rating would have been spare. Furthermore, space would have been needed for three sets of high-tension gears. Of the single-phase type four units are used, including a spare one—that is, only one-quarter of the transformer rating is spare and only one set of high-tension gear is needed instead of three. Moreover, the single-phase transformers are safer in service than those of the three-phase type on account of their simpler design. From these considerations the single-phase transformers were chosen for both these stations, the rating per unit being 370 kva.

The circumstances at Kristianstad are almost analogous with those at Ifö and Maltesholm. It was desirable to install transformers for 2000 hp at this station in the beginning, and it was therefore advantageous to divide the transformers into two 1000-hp groups. The single-phase system proved to be the best here also, because for six single-phase transformers only one spare is needed. In Sölvesborg, however, the value of the power was so small that only the three-phase type could be taken into consideration and two 100-kva units were chosen. All of these transformers are of the self-cooled, oil-insulated type.

The high-tension installation in all of the transformer stations has been arranged on the cell system. The conductors are enclosed between fireproof walls and barriers. For the barriers use has been made of a special kind of brick called Frazzi brick, consisting of terracotta. The brick is hollow and shaped as slabs, the dimensions being 2¼ in. x 10 in. x 24 in.; it has proved very good for the purpose, as it is strong, light and very homogeneous, fireproof and to a certain degree insulating in electrical respect. It resists an electric arc and does not crumble when heated and suddenly covered with water.

The vertical barriers have been erected with the brick edgewise and one end to the wall to which the barrier is attached; the other end is guided by a vertical U-iron finishing and limiting the wall outward. Anchor bolts have been placed at intervals in the supporting wall. These bolts are drawn through the holes in the Frazzi slabs and the U-iron. The U-irons and bolts are very advantageous from the electrical point of view, as the former limit the barriers and are grounded.

At the horizontal walls the Frazzi brick has been framed between two U-irons connected by bolts through the holes in the slabs. This construction is also very solid and the barriers are self-supporting at almost any span.

In every transformer station there has been provided for each of the incoming and outgoing lines a lightning arrester consisting of two arresters of horn-type connected in series on each phase, and a water resistor connected in parallel with one gap (Fig. 16). There is also in every station a lightning arrester of the multigap type consisting of a number of small gaps and carborundum resistors.

The incoming Hemsjö line passes through disconnecting switches, choke coils and an oil switch to the high-tension busbars. From these the line to Maltesholm branches off through disconnecting switches and oil switches. The low-tension side of the transformers has fuses and non-automatic oil switches. The e.m.f. is 5000 volts. The conductors on both the high-tension and low-tension side consists of bare hard-drawn copper wire. The neutral on the secondary is grounded. The transformers are enclosed in fireproof chambers on the bottom floor of the building, the switchgear being on the upper floor.

It might be of some interest to give a few data regarding the cost of the plant in question. The cost for the different parts has been approximately as follows:

Hydro-mechanical equipment, including tubes, turbines and regulators of the Upper Hemsjö Power Station	$17,500
Electric equipment of the Upper Hemsjö Power Station	36,000
Buildings, etc., at the Upper Hemsjö Power Station	23,000
The transmission lines	87,500
Telephone lines	5,000
The primary and secondary transformer stations, cable system and distribution system	72,300
Transformer station buildings	18,700
Total cost	$260,000

The transmission lines have cost on an average $1,460 per mile. This rather high cost can be explained by the very high price of copper during the year 1907. The company had to pay $2.70 per pole to the owners of the ground for right of way. The telephone lines cost $86 per mile.

The contractors have been the Maschinenfabrik Oerlikon, Switzerland, for the power station; the Luth & Rosén Electric Company, Stockholm, Sweden, for the transmission lines, and the Förenade Elektriska Aktiebolaget, Stockholm, for the transformer stations. The consulting electrical engineers for the company have been the Elektriska Pröfningsanstalten, Stockholm. The writer has superintended the erection of the power station, transmission lines and transformer stations for these engineers.

Voltage Strains Due to Circuit-Breaking in Direct-Current Systems.

BY L. SILBERBERG.

THE relation of current and voltage when uniform direct current exists in a circuit is as unchanging as the law of gravitation. With the resistance of the circuit known an application of Ohm's law defines this relation very simply. Moreover, the circuit-breaking devices of most direct-current lines act uniformly in the service for which they were designed and are surrounded by a medium whose characteristics change but little. The question then arises: Is it not probable, during the operation of circuit breaking, that the transient values of current and voltage still bear to each other a relation which remains the same as long as the constants of the circuit and the manner of breaking it remain unchanged?

In the following calculations an attempt is made to define these transient current and voltage values, in order to ascertain what strains a circuit may undergo during the opening period.

CURRENT REDUCED BY RHEOSTAT BEFORE CIRCUIT IS OPENED.

The method of opening a circuit by increasing the resistance is used most frequently in connection with low-voltage release attachments on motor-starting rheostats. Field-circuit currents of generators also may be reduced in the same way. It is known that no abnormal voltages are encountered unless the circuit is highly inductive and the resistance is cut in with considerable rapidity. Evidently when the resistance and inductance of the circuit are constant, the rapidity with which an outside resistance is cut in is largely responsible for the current and voltage values that ensue; and any attempt to investigate these values demands a knowledge of the variable resistance inserted.

The equation for resistance of a conductor is

$$R = \frac{\rho\, l}{A} \qquad (1)$$

where R = resistance, ρ = a constant, called the resistivity, l = length of conductor, and A = area of cross-section of conductor. If the conductor taken is an ordinary rheostat, and the resistance R is assumed to vary from zero to a finite value after the time t, the following conditions exist: ρ is still a constant, being the resistivity of the resistance material; A

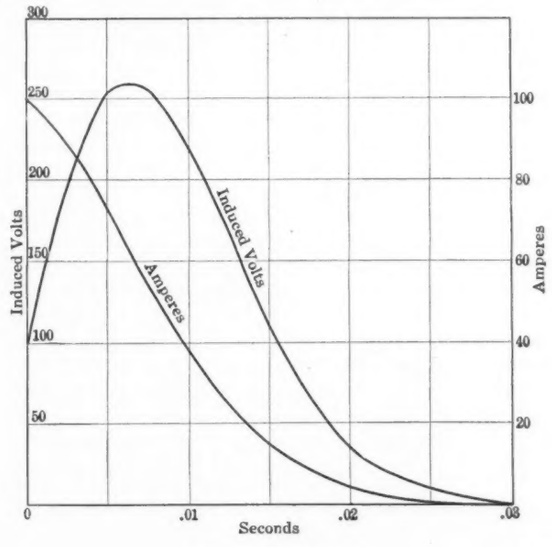


FIG. 1.—PROBLEM 1.

is still a constant, being the cross-section of the resistance material; therefore, $\rho \div A$ is constant; l is a variable, depending on the amount of resistance inserted in the time t, the action of the rheostat decreeing that l increases as t increases. The length l can be made to increase directly as the time, as the square, cube or any exponent of the time. In general, it is assumed that l varies as t^n, or $l = ct^n$, where c is a constant.

Rewriting equation (1),

$R = \frac{\rho}{A}\, ct^n$ or combining c and $\frac{\rho}{A}$ into the constant k,

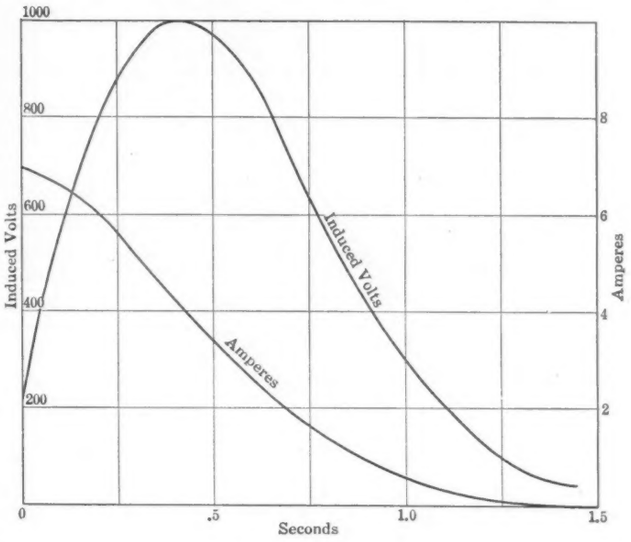


FIG. 2.—PROBLEM 2.

$R = k\, t^n$ is the equation defining the variable resistance inserted. If

i_o = initial current, in amperes, in circuit,
e_o = initial pressure, in volts,
r = resistance in ohms,
L = inductance in henrys,
i = current in amperes after time t,
e = pressure in volts after time t,

then if, at the instant of starting the reduction of current in a circuit, the impressed voltage were withdrawn, the current due to the induced volts could be written

$$i = \frac{-L\frac{di}{dt}}{r + kt^n}, \text{ or}$$

$$-L\frac{di}{dt} = i\,(r + kt^n)$$

$$\frac{di}{i} = -\frac{1}{L}\,(r + kt^n)\,dt.$$

Integrating,

$$\log_\varepsilon i - \log_\varepsilon c = -\frac{1}{L}\left(rt + \frac{kt^{n+1}}{n+1}\right)$$

where c is a constant of integration.

$$\log_\varepsilon \frac{i}{c} = -\frac{t}{(n+1)\,L}\,[(n+1)\,r + kt^n]$$

from which

$$i = c\,\varepsilon^{\frac{-t}{(n+1)\,L}\,[(n+1)\,r + kt^n]} \qquad (2)$$

When $t = o$, $i = i_o$, which value substituted in (2) gives

$$i_o = c.$$

Therefore,

$$i = i_o\,\varepsilon^{-\frac{t}{(n+1)\,L}\,[(n+1)\,r + kt^n]} \qquad (3)$$

the transient current,

$$e = i\,(r + k\,t^n)$$

$$= i_o\,(r + kt^n)\,\varepsilon^{-\frac{t}{(n+1)\,L}\,[(n+1)\,r + kt^n]} \qquad (4)$$

the transient voltage.

Two examples illustrating the application of these equations are given:

(1) In a circuit of 1-ohm resistance and 35 milhenrys inductance a current of 100 amp is flowing due to an e.m.f. of 100 volts impressed upon it. What will be the resultant current and induced voltage values, if a rheostat is made to introduce a constantly increasing resistance at the rate of 500 ohms per second?

(2) In an alternator field having a resistance of 33.2 ohms and an inductance of 112 henrys, a current of 6.93 amp is flowing, due to an e.m.f. of 230 volts impressed upon it. What will be the values of current and induced voltage if a rheostat is made to introduce a constantly increasing resistance at the rate of 500 ohms per second?

Figs. 1 and 2 show the solutions of problems 1 and 2, respectively. It is seen that the voltage equation has a maximum value in each case. The time at which the maximum value would occur in equation (4) could be determined by equating the first derivative of voltage with respect to time to zero and solving for t. By carrying out this operation t is seen to be involved in the equation

$$(r+kt^n)^2 = n\,k\,L\,t^{n-1} \qquad (5)$$

from which, in a numerical case, t can be found by a cut-and-try process. Substituting this value in equation (4) makes it possible to determine the maximum value of the induced voltage without plotting a curve.

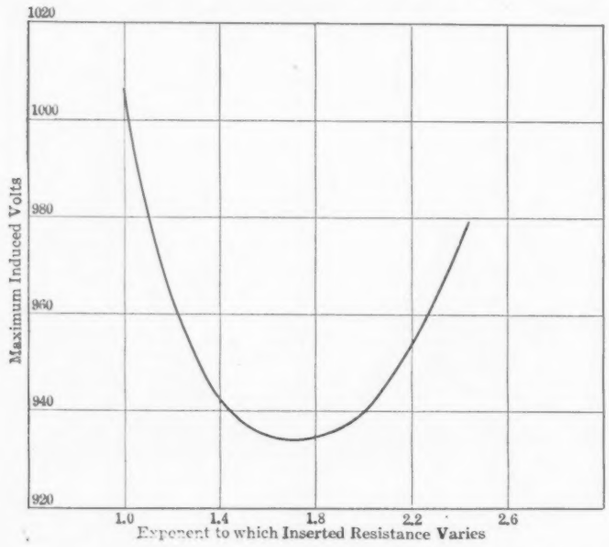


FIG. 3.—CURVE OF VARIATION OF MAXIMUM INDUCED VOLTAGE.

The constant k can be defined as the resistance, in ohms, that has been inserted after the first second of time. In problems 1 and 2 this resistance is taken as 500 ohms and n is taken as 1; that is, the resistance varies directly as the time. If k were kept the same, but the resistance were made to vary as the square of the time, it is evident that another set of voltage values would be obtained and, therefore, a different maximum value of the voltage would result. In general, it may be said that every change in the exponent n produces a corresponding change in the value of the maximum induced voltage, all other conditions being held the same. Fig. 3 shows a curve of this variation, the same circuit being used as in problem 2. The curve shows that for this particular circuit and speed of inserting the resistance, if the resistance in ohms could be made to vary as the 1.7 power of the time in seconds, a smaller value of the induced voltage would result than if the resistance were varied in any other way. In general, it can be shown that the phenomenon is true for any circuit, viz., that when the resistance and inductance of a circuit and the speed of inserting resistance in it are given, there is a way of inserting this resistance that will cause less induced voltage than any other way.

Other phenomena shown by equations (3), (4) and (5) are that, when all other conditions of the circuit are held the same: (1) An increase in the resistance of the circuit causes a decrease in the induced voltage and a quicker subsidence of the current. (2) An increase in the inductance of the circuit causes an increase in the induced voltage and a slower subsidence of the current.

It can be shown, also, that the energy consumed in stopping the current is the same, regardless of the way in which it is stopped; for

$$W = \int_0^\infty i\,e\,dt$$

$$= i_0^2 \int_0^\infty (r+kt^n)\,\varepsilon^{-\frac{2t}{(n+1)L}[(n+1)r+kt^n]}\,dt$$

$$= -\frac{i_0^2 L}{2}\int_0^\infty \varepsilon^{-\frac{2t}{(n+1)L}[(n+1)r+kt^n]}\left[-2\left(\frac{r+kt^n}{L}\right)\right]d$$

$$= -\frac{i_0^2 L}{2}(0-1)$$

$$= \frac{i_0^2 L}{2}$$

CIRCUIT OPENED BY A CARBON BREAK CIRCUIT-BREAKER.

When (as is the common practice now) a circuit is opened by a single-pole carbon break circuit-breaker, an ordinary statement of the occurrence would be that the carbon contacts fly apart the full length of their throw with great speed. An arc is formed which flies upward and dies away.

If it were not for this arc, the circuit would be broken almost instantaneously; and it might be said that the arc is a temporary conductor created by the circuit in order to protect itself against the effect of being opened too rapidly. Considered as a conductor, then, the arc should have length, cross-section and resistivity and be subject to the same law of resistance that governs other conductors, i. e., $R = \frac{\rho\,l}{A}$.

Since the area of cross-section depends on the current flowing it ought to be possible to substitute i for A and by giving ρ another value, the equation should still hold. Another question presents itself: how does the length of an arc, formed under the above conditions, vary with the time? Counting time from the instant that the contacts have reached the end of their throw the arc might be considered as a straight beam, perfectly elastic and flexible, stretching between the contacts. Due to the pressure of air below it, from convection, this beam may be said to be acted upon by a set of forces of the same value and distributed uniformly along its length. Therefore, in order to preserve the same stress among all of its particles, it tends at any instant to assume the shape of the moment diagram of a beam so loaded, i. e., a parabola. The rate at which the vertex of the parabola rises is probably not far from being uniform and, for purposes of calculation, it is assumed to be so. Therefore, since the length of arc of this curve increases almost at the same rate as the path traveled by the vertex, it also may be said to increase uniformly. In other words, the length of path traveled by the current during this transient period varies directly as the time.

When an arc rises for a considerable distance above the contacts before rupturing, another set of forces assume some prominence; they are the lines of force surrounding the path of the current and tend to force the arc apart as the shape of it approaches a loop. No calculations are based on these, however.

If, then, the cross-section of this arc conductor is assumed to vary directly as the current and the length of it to vary directly as the time, we may rewrite its resistance equation in the form $R = \frac{\rho\,t}{i}$. The current, during the period of circuit-breaking, is due to the impressed voltage plus the induced voltage and could be written

$$i = \frac{e_0 - L\frac{di}{dt}}{r+\frac{\rho t}{i}} \quad \text{or}$$

$$ir + \rho t = e_0 - L\frac{di}{dt},$$

from which $$\frac{di}{dt}+\frac{r}{L}\ i=\frac{e_o-\rho t}{L}.$$

Multiplying by the integrating factor $\epsilon^{\frac{rt}{L}}\,dt$,

$$\epsilon^{\frac{rt}{L}}\,di+i\epsilon^{\frac{rt}{L}}\,\frac{r}{L}\,dt=\frac{e_o}{L}\,\epsilon^{\frac{rt}{L}}\,dt-\frac{\rho}{L}\,t\,\epsilon^{\frac{rt}{L}}\,dt$$

or

$$\epsilon^{\frac{rt}{L}}\,i=\frac{e_o}{L}\int_o^t\epsilon^{\frac{rt}{L}}\,dt-\frac{\rho}{L}\int_o^t t\,\epsilon^{\frac{rt}{L}}\,dt$$

$$=i_o\,\epsilon^{\frac{rt}{L}}-\frac{\rho}{r}\,t\,\epsilon^{\frac{rt}{L}}+\frac{\rho L}{r^2}\,\epsilon^{\frac{rt}{L}}+c,$$

where c is an integration constant.
When $t=o$, $i=i_o$ which values substituted in the above, gives

$$i_o=i_o+\frac{\rho L}{r^2}+c$$

$$c=-\frac{\rho L}{r^2}$$

Therefore,

$$\epsilon^{\frac{rt}{L}}\,i=i_o\epsilon^{\frac{rt}{L}}-\frac{\rho}{r}\,t\,\epsilon^{\frac{rt}{L}}+\frac{\rho L}{r^2}\,\epsilon^{\frac{rt}{L}}-\frac{\rho L}{r^2}$$

$$i=i_o-\frac{\rho t}{r}+\frac{\rho L}{r^2}\left(1-\frac{1}{\epsilon^{\frac{rt}{L}}}\right) \qquad (6)$$

the transient current.

$$e=e_o-L\,\frac{di}{dt}=e_o+\frac{\rho L}{r}\left(1-\frac{1}{\epsilon^{\frac{rt}{L}}}\right) \qquad (7)$$

the transient voltage.

The circuits used in problems 1 and 2 will be used again to illustrate the application of the above equations of current and voltage. The problems may be re-stated as follows:

(3) A circuit having a resistance of 1 ohm and an inductance of 35 milhenrys has a current of 100 amp flowing in it due to an impressed e.m.f. of 100 volts. What will be the current and voltage values during circuit-breaking?

(4) A circuit having a resistance of 33.2 ohms and an inductance of 112 henrys has a current of 6.93 amp flowing in it due to an impressed e.m.f. of 230 volts. What will be the current and voltage values during circuit-breaking?

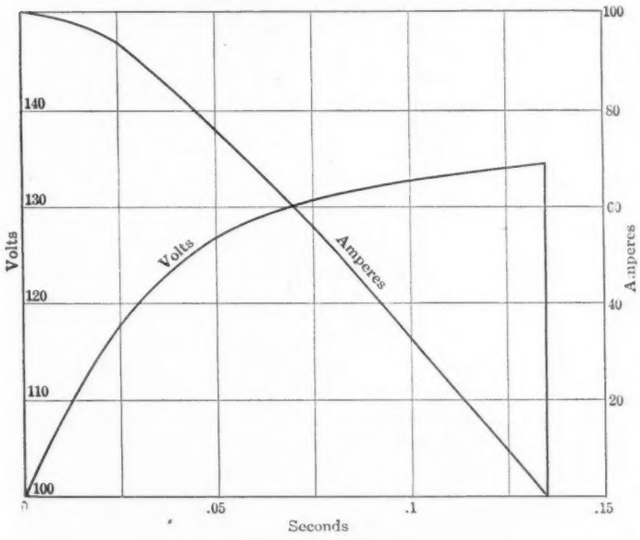


FIG. 4.— PROBLEM 3.

It is understood that a carbon break circuit-breaker is used in these problems. The solutions are shown on Figs. 4 and 5. It is seen that the maximum voltage value is reached when the current reaches zero. The maximum voltage value could be determined without plotting a curve if the time at which the current reached zero were known. If, in equation (6), i were put equal to zero, then

$$\frac{\rho}{r}\left(t+\frac{L}{r\epsilon^{\frac{rt}{L}}}\right)=i_o+\frac{\rho L}{r^2}$$

or

$$t+\frac{L}{r\epsilon^{\frac{rt}{L}}}=\frac{e_o}{\rho}+\frac{L}{r} \qquad (8)$$

from which t could be found, in a numerical case, by a cut-and-try process.

In general lighting and power work circuit-breakers are rarely used in circuits having an appreciable inductance, and the voltage strains are seldom injurious. In railway feeder circuits, however, especially those with the third-rail, the material and size of the conductor and its low resistance are liable to make the ratio of inductance to resistance unduly high. This ratio, as can be seen by equation (7), is largely responsible for the voltage strain encountered when circuit breaking. As an example, suppose such a circuit, having a resistance of 0.4 ohm and an inductance of 2 henrys, was opened by a short-circuit current of 1500 amp. As found by equations (7) and (8), the time for the arc to rupture would be 2.68 seconds and the maximum voltage 2675 volts. Thus, it is seen that, while the inductance of this circuit is only a small fraction of that in problem 4, the voltage strain when circuit breaking is about twice as great.

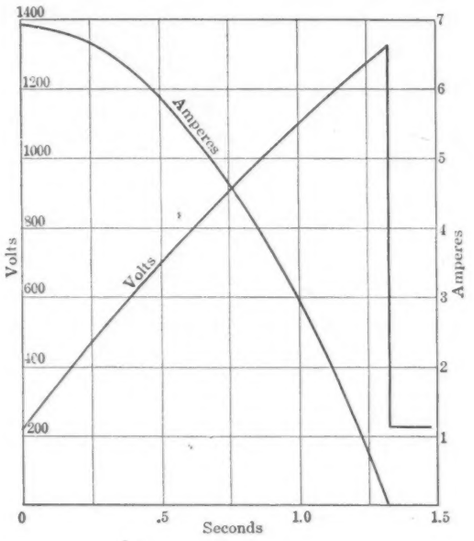


FIG. 5.—PROBLEM 4.

The value of the constant ρ has been assumed as 1000 in the foregoing problems. It probably never has been determined experimentally; it should be about constant for conditions under which circuit-breakers are usually placed.

Electrolytic Detectors.

In *Der Elektrotechniker*, of Vienna, Mr. H. J. Reiff describes the electrolytic detector of Schloemilch, in which a direct current is passed through an electrolytic cell between a platinum plate and a fine platinum point as electrodes. The application of this cell as a wave detector depends on the fact that if the cell is subjected to the action of a wave (by connecting the platinum-plate electrode with the antenna), the resistance of the cell is changed. Branby has found that by raising the temperature to 60 deg. C., the sensitiveness of the cell can be made a maximum. The sensitiveness of the cell seems to depend on the ease with which the small gas bubbles, set free at the electrode by the direct current, can detach themselves from the electrodes. By rocking the cell or by blowing an air current against the electrodes, the sensitiveness of the cell is increased.

Pulley Data: Ratio of Diameters, Distance Between Centers and Arc of Contact.

By F. C. Helms.

IN the laying out of power plants and shops in which belts and pulleys are to be used, it is desirable to have the mathematical formulas, which are used for calculating the various dimensions, arranged in the form of curves, charts or tables, thus enabling one to obtain the desired results with the

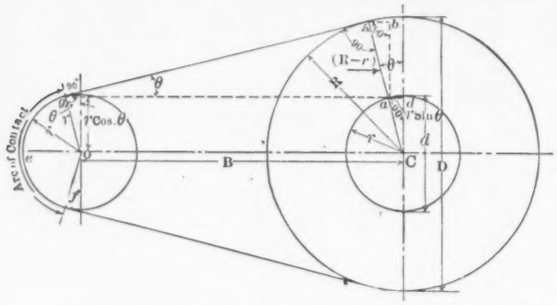


FIG. 1.—DIAGRAMMATIC SKETCH SHOWING RELATIONS BETWEEN VARIOUS FACTORS OF BELT-DRIVE.

expenditure of the least amount of mental energy. The curves shown in Figs. 2 and 3 are presented with this object in view.

Fig. 1 gives a diagrammatic picture of the relations existing between the various factors, such as the ratio of the diameters D/d; the distance between centers B, and the arc of contact on the smaller pulley.

From Fig. 1 the following formula for the distance between centers B in terms of the ratio of the diameters D/d and the angle Θ can easily be derived:

$$B = \frac{(D/d - 1)}{2 \sin \Theta} d \qquad (1)$$

which is in a form convenient for calculating the value of B in terms of the ratio of diameters and the arc of contact on the small pulley since $\Theta = \frac{180° - \text{arc of contact}}{2}$

It is evident that curves plotted between the ratio D/d and $\frac{D/d - 1}{2 \sin \Theta}$ will be straight lines passing through the origin; hence it will be only necessary to calculate one or two points for each value of the arc of contact, which will enable one to draw straight line curves for as many values of the arc of contact as may be desired.

The following calculations of equation (1) are added simply to show the tabulated method:

D/d	D/d − 1	$\frac{D/d - 1}{2 \sin \Theta}$			
Arc of Contact		175°	170°	165°	160°
1	0	0	0	0	0
4	3	34.4	17.2	11.5	8.65
7	6	68.8	34.4	23.0	17.3

The curves in Fig. 2 were plotted from calculations as indicated above. They enable one to determine at a glance the distance between the centers of the pulleys which should obtain (when the ratio of diameters is fixed, the size of either pulley being known) in order to obtain a given arc of contact on the small pulley.

The curves in Fig. 3 give the arc of contact which will be obtained on the small pulley for several values of the ratio $D \div d$ when the centers of the pulleys are separated by any distance from 0 up to $35d$. These curves were plotted directly from the curves in Fig. 2, although equation 1 can be transformed into the following form:

$$Sin\ \Theta = \frac{D/d - 1}{B} \frac{d}{2} \qquad (2)$$

and calculations of the value of sin Θ made for several definite values of $D \div d$, where B will be the varying factor, d being made unity for convenience. The arc of contact can easily be obtained when we know the value of Θ.

To show the use of the curves take the following case: Suppose that there is an engine running at 150 r.p.m. and equipped with a belt pulley 127 in. diameter and 48 in. face. This gives a belt speed of 5000 ft. per minute. It is desired to install a 60-cycle, 500-kw alternating-current generator to be driven by this engine, and there is available a distance of approximately 30 ft. between the center lines of the pulleys. What is the maximum r.p.m. at which the generator can be run to obtain an arc of contact of 165 deg. on the small pulley?

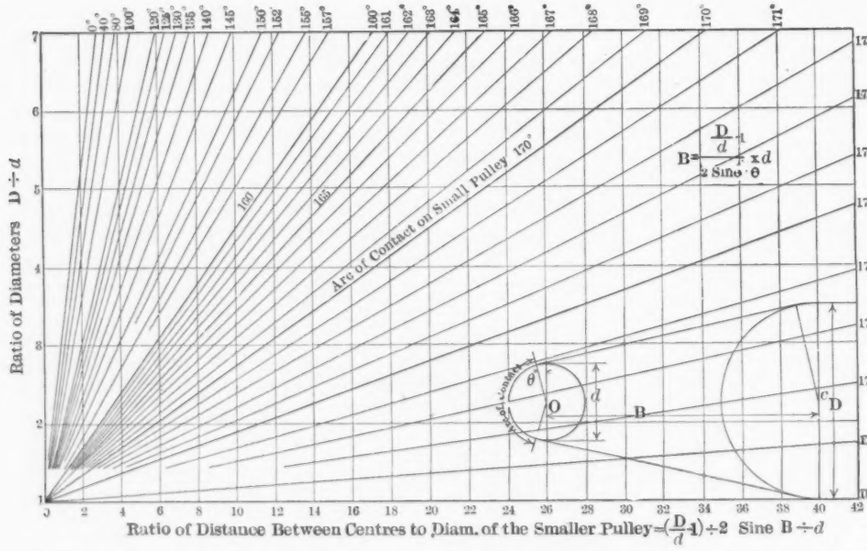

Ratio of Diameters D ÷ d
Arc of Contact on Small Pulley 170°
B = (D/d − 1) ÷ 2 Sine θ × d
Ratio of Distance Between Centres to Diam. of the Smaller Pulley = (D/d − 1) ÷ 2 Sine B ÷ d

FIG. 2.—CURVES PLOTTED BETWEEN RATIO OF DIAMETERS OF PULLEYS AND RATIO OF DISTANCE BETWEEN CENTERS TO DIAMETER OF SMALLER PULLEY FOR VARIOUS VALUES OF ARC OF CONTACT ON SMALLER PULLEY.

One may start with the assumption that a four-ply leather belt 46 in. wide will transmit 500 kw at a belt speed of 5000 ft. per minute with an arc of contact of 165 deg. on the small pulley. The calculation of the size of this belt requires the use of a formula or another set of curves designed for this purpose. It is also possible to run a four-ply belt approximately 0.75 in. thick on a pulley as small as 30-in. diameter. Taking this latter diameter of 30 in. and making a preliminary calculation of the r.p.m. of the generator there is obtained:

$$S = \frac{5000}{30/12 \times \pi} = 637$$

Selecting 600 r.p.m. and 12 poles for the generator, there will be obtained a frequency of $\frac{600 \times 12}{2 \times 60} = 60$ cycles per second.

Now calculating the diameter of the generator pulley required at 600 r.p.m.,

$$d = \frac{5000}{600\pi} \times 12 = 31.8''$$

Hence, $D/d = 127/31.8 = 3.9$ and the arc of contact equal to 165 deg. with which to enter the curves.

With these values of D/d and the arc of contact, from the curves in Fig. 2 one can find the ratio of the distance between the centers B to the diameter of the small pulley d or $B/d = 11.5$; hence $B = \frac{11.5 \times 31.8''}{12} = 30.5$ ft., which is approximately equal to the specified distance of 30 ft. available.

Again, suppose there is given the diameter of the small pulley $d = 3$ ft., $B = 30$ ft., or $B/d = 10$, and also the ratio $D/d = 3.5$, what arc of contact will be obtained on the small pulley?

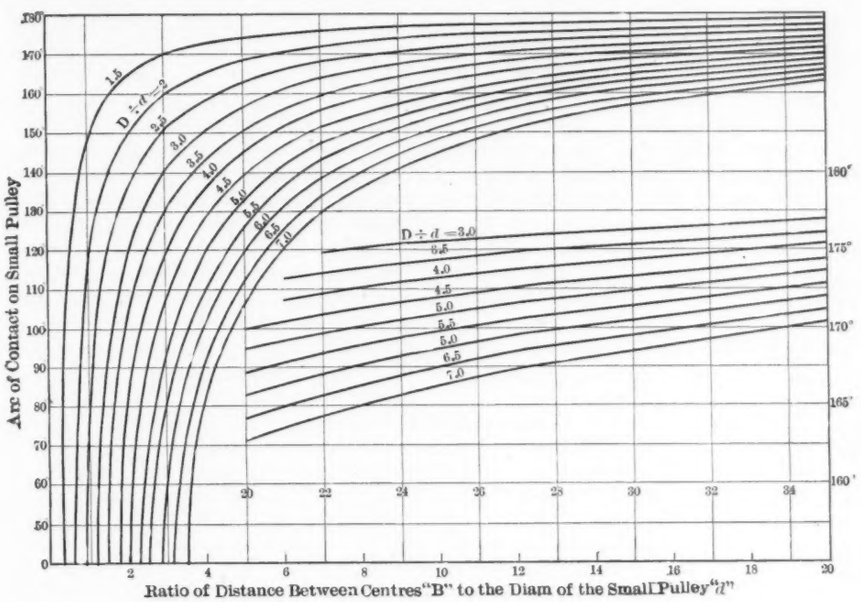


FIG. 3.—CURVES PLOTTED BETWEEN ARC OF CONTACT ON SMALLER PULLEY AND RATIO OF DISTANCE BETWEEN CENTERS OF PULLEYS "B" TO DIAMETERS OF SMALLER PULLEY "d" FOR VARIOUS VALUES OF RATIO OF DIAMETERS OF PULLEYS.

Referring to Fig. 3, the vertical ordinate through 10 meets the curve labeled $D/d = 3.5$ at point 165.5 deg. which gives the desired arc of contact. Instead of having D given, suppose it is desired to find the diameter D which, with the above data, will give an arc of contact of 160 deg. In this case use is made of Fig. 2, where the ordinate through $B/d = 10$ meets the 160 deg. arc of contact line at the point $D/d = 4.47$; hence, $D = 4.47 \times 3. = 13.4$ ft.

The Theory of Lightning.—I.

By Daniel S. Carpenter.

GREAT progress has been made in adapting natural forces and resources to our use, yet there are some forces which as yet we are unable to control. One of these is lightning. To illustrate its destruction of life and property, in 1898 records show that in the United States 367 persons were killed by lightning. The property loss which could be directly traced to lightning strokes was $1,441,880. The value of the live stock killed by it was $48,275; 7558 fires owe their origin to it. In 1900 the records show that 713 persons were killed and 973 injured by lightning. This is a large increase and is probably due to a more complete and extensive system of obtaining records. If every case could have been recorded there is no doubt but that the number would have been still larger.

Power transmission systems suffer greatly from it unless they are well protected. The loss occasioned by the crippling of lines or apparatus and the consequent failure to maintain continuity of service, the expense required to procure effective lightning protection, and the inconvenience to which the public is subjected by interruption of service, justify the maintenance of a corps of experts by the large commercial companies who devote their time to the study of lightning and lightning protection or possibly lightning prevention.

The accumulation of charges of electricity on the clouds is closely associated with the condensation of vapor and the formation of raindrops. Investigation has revealed the fact that the atmosphere is electrified and that there exists a potential gradient in the direction of the vertical. The higher strata of the air have a positive potential against ground during fair weather. The strata of the air in which the clouds float thus have a potential difference against ground amounting perhaps to thousands of volts. The minute particles of vapor floating in the air must necessarily assume a potential. If the surrounding air was dry and the moisture particle was a conductor of such form and magnitude as to prevent the charge from escaping, under these ideal conditions the conductor would assume the potential of the air in which it floats. But these ideal conditions do not exist, for the vapor particles begin to unite to form drops before this value is reached. The positive electrification of the air acts inductively upon the minute particles of vapor. The negative electricity escapes from these and they assume a potential. Experiments show that when an electric field is directed upon vapor particles or very fine drops they combine, and the vapor assumes a heavier and darker appearance. We have the same process on a large scale here. Under the influence of the electric field or electromotive intensity due to the electrification of the air and the vapor particles, the combination of vapor particles to form drops is greatly facilitated. It appears that the number of particles which unite to form drops is a function of the electromotive intensity within the limits between which this influence is manifested—i.e., there would be a great tendency toward the union of particles in obedience to this influence, but the influence would become less effective as the drops grew larger, for equilibrium could not result unless a condition was reached in which the influence could produce no further union. This certainly would be a very interesting field for investigation. From the very nature of the process it is clear that large quantities of electricity must accumulate on the clouds during the agglomeration of vapor particles into raindrops. The clouds are imperfect conductors, thick dense cloud masses being separated from one another by spaces in which there is comparatively little vapor. This can be seen if one observes the clouds closely, and the observations of balloonists prove it to be a fact. The charge on each cloud must act inductively on all the other clouds within the field of influence. This adds greatly to the cloud charges, as will be clearly evident later.

Suppose that n^3 vapor particles unite to form one raindrop, considering both to be spherical in shape, as this must be approximately true. The radius of the raindrop will be n times as great as that of one of the particles, while its capacity considered as an isolated sphere will be n times as great. The density of the charge on the raindrop will be n times as great as that on one of the particles of moisture, while its potential will be n^2 times as great. Suppose that ultimately the raindrops have a diameter of .252 centimeter or approximately one-tenth of an inch. Such a drop considered as an isolated sphere would have an electrostatic capacity of .126 electrostatic units and a potential of $\frac{Q}{r}$ electrostatic units, where Q is the charge and r the radius of the drop. Suppose that $Q = 4$; then, if the charge

were uniformly distributed, $\frac{Q}{r}$ would represent the potential and would be equal to $\frac{4}{.126} = 31.7$ electrostatic units. Reduced to volts this equals 9510 volts. Thus, the potential of a raindrop cannot be enormously high and of the magnitude of lightning potential.

A spherical conductor whose diameter is .252 centimeter, if surrounded by dry air and removed from the influence of all other conductors, will be just large enough to hold a charge of 4 electrostatic units under ordinary conditions as to temperature, pressure and humidity. For the pressure of the charge of an electrified conductor, which manifests itself as a mechanical force acting in the direction of the exterior normal to the surface of the conductor against the surface of the surrounding dielectric is $2\pi\sigma^2$ dynes per square centimeter, where σ is the density of the charge on the conductor in electrostatic units per square centimeter. If the conductor is surrounded by dry air the greatest value of $2\pi\sigma^2$ at ordinary conditions in regard to temperature, humidity and pressure of the atmosphere is 800π. This corresponds to a density of 20 electrostatic units per square centimeters. In the case of an isolated and insulated sphere, $C = r$, where C is the capacity and r the radius. As $\sigma = \frac{Q}{\pi d^2}$, for the case where $2\pi\sigma^2 = 800\pi$, we have $d = \sqrt{\frac{Q}{20\pi}}$ For $Q = 4$, $d = 0.252$ centimeter.

If the value of Q, the charge of a vapor particle, and d, its diameter, are known, one could calculate the maximum value of n approximately at which the charge would escape from the raindrop. Since $Q = n^3 Q_1$ and $d = nd_1$, $\sigma = \frac{n^3 Q_1}{\pi (nd_1)^2} = 800\pi$ or $n = \frac{800\pi^2 d_1^2}{Q_1}$

But the raindrops are not isolated spheres. The case of a cloud of charged raindrops corresponds to the case of a large number of insulated conductors, to each of which initially a charge of electricity of the same sign has been imparted. Let $A_1, A_2, A_3 \ldots A_n$ represent n such conductors. If $P_{11}, P_{12}, P_{13} \ldots P_{1n}$ represent the potential functions on $A_1, A_2, A_3 \ldots A_n$ due to a unit charge on A_1, then $Q_1 P_{11}$ $Q_1 P_{12} \ldots Q_1 P_{1n}$ will represent the corresponding potential functions due to Q_1 units on A_1. Similarly with Q_2 units on A_2, Q_3 units on A_3, etc. The potential function of A_k due to its own charge of Q_k units and to the charges on it induced by the charges $Q_1, Q_2 \ldots Q_n$ on the other conductors will be—

$$V_k = Q_1 P_{1k} + Q_2 P_{2k} + Q_3 P_{3k} + \ldots + Q_k P_{kk} + \ldots + Q_n P_{nk}. \quad (A)$$

It is thus seen that the potential of the drop is a function of many variables. Let Q_1 and S_1, Q_n and S_n represent the charge and area of a particle of vapor and of a raindrop respectively, the raindrop being formed by the union of n^3 particles of vapor. Then $Q_n = n^3 Q_1$, $S_n = n^2 S_1$ and $\frac{Q_n}{S_n} = n \frac{Q_1}{S_1}$, i.e., the density of the charge on the raindrop is n times as great as that on the particle of vapor and the mechanical force which tends to cause the charge to leave the conductor is n^3 times as great, for $2\pi\sigma_n^2 = 2\pi(n\sigma_1)^2 = 2\pi\sigma_1^2 \times n^2$. It must result from this rapid increase of potential and mechanical pressure that the air in contact with the drop will quickly break down and become conducting at some point. If the drop was an isolated conductor surrounded by perfectly dry air, when the charge was again in equilibrium, it would be distributed over the surface of a conductor consisting of the original conductor surrounded by an envelope of conducting air. The air immediately in contact with the surface of the conducting air would not be broken down and conducting, but would be the seat of great activity. As the potential increases, streamers and brushes would dart out into the surrounding air. This presents a luminous appearance in the dark. This is called corona, and exists about small conductors charged to a high potential. It is very destructive of insulation.

The raindrops are surrounded by moist air, and the distribution of the charge is modified by induction from the charges on the other raindrops near by and by the potential gradient. So the density is greater at some places than at others, and it is probable that the density becomes so great at some point that the charge readily escapes into the air.

Considering the second member of equation (A), it has been found that the first term will be n^3 times as great for the drop as for the particle. As vapor is continually rising, when the particles have united into drops there would still be other particles with charges and the quantity of electricity would be increased over that which was present when the first drops were forming. The particles that were uniting into drops in the presence of the charged raindrops would have a higher potential than the first set and their tendency to unite would be greater.

In the case of a conductor no charge exists in the interior. In the case of the cloud, which is an imperfect conductor, the tendency will be for the electricity after escaping from the drops to pass to the surface of the cloud. This tendency will be greatly increased by the electromotive intensity due to charges on the clouds in that vicinity.

Taking the simplest case, suppose that the cloud is spherical in shape, the case being that of a hollow conductor with a charge on its surface and innumerable small charges within. No electromotive intensity exists in the interior due to the free charge on its surface or the external charges, except that due to the increase in the magnitude of these charges and sudden changes in their distribution.

The potential of a raindrop in the cloud will be $V_1 + V_2$, where V_1 is the potential due to the raindrops and particles of moisture within the cloud, and V_2 is that due to the charge on the cloud. With the charge on the cloud constant and in equilibrium the value of V_2 would be constant and the same at all points within the cloud.

The charge on the cloud's surface shields the raindrops and vapor particles within the cloud from the influence of charges without.

After heavy charges have accumulated on the clouds, the electromotive intensity will be the resultant of the normal potential gradient and that due to the cloud charges and so may be in any direction and will change as clouds discharge or as the charges rearrange themselves on their respective clouds. Suppose that a cloud discharges. Its potential is reduced to a very low value. The electromotive intensity in the direction of this cloud becomes momentarily very great as equilibrium is being restored by readjustment of charges on the other clouds, thereby causing the particles of moisture to unite very rapidly and the influence of the electromotive intensity in the formation of raindrops reaches a state of maximum intensity. This action results in the formation of large drops and the accumulation of a second charge on the cloud's surface. The practically instantaneous establishment of a strong electromotive intensity causes the particles to flash into drops of such magnitude that the electricity can escape and then sweeps the charges from the drops toward the cloud's surface, causing a second discharge immediately after the first. This is the explanation of multiple flashes and the heavy rainfall of large drops which often occur after a lightning flash. The number of discharges in a multiple flash will increase with the size of the cloud and the presence of heavily charged clouds in the vicinity. These will produce a strong electromotive intensity after each discharge, and, of course, the larger the cloud the longer will be the time required for all its electricity to reach its surface. As water is continually evaporating and the vapor rising, the process of the charges collecting on raindrops then escaping and passing to the surface of the clouds will be repeated over and over again.

Considering the lowest clouds—the clouds in the lowest horizontal layer—which are the ones seen when the sky is overcast and the ones in which most of the flashes which are seen originate, it is noteworthy that there are no charged clouds below these. Thus, heavily charged clouds above, if their charges are of the same sign, repel their charge to the lower surface, increasing the cloud's potential and the density of the charge

there, thereby assisting in establishing conditions favorable to a discharge to earth. Where two clouds have charges of opposite sign, the density of the charges will be greatest on the portions which are the nearest to one another. It is probable that the attraction between clouds having charges of opposite sign alters their form in such a manner as to facilitate a discharge between them. Applying the nomenclature used above to clouds instead of raindrops, there is obtained the charge on A_k,

$$M_k = V_1 q_{1k} + V_2 q_{2k} + \ldots + V_k q_{kk} + \ldots + V_n q_{nk}.$$

where the q's are functions of the p's in the value of V_k.

The electromotive intensity at a point is the resultant of that due to several cloud charges and will vary with changes in these.

In confirmation of this theory, we may quote from the experience of the balloonist, M. Lecoq. His ascent was so timed as to bring him within the range of an approaching thunderstorm. At the height of 600 meters the balloon moved rapidly toward the storm cloud as if attracted by it. At 7:40 p. m., and at a height of 1100 meters, it entered a mass of gray-green cloud, which was momentarily lit up by fitful lightning flashes, followed by immediate and deafening thunderclaps. The discharge appeared to take place between this cloud and another directly overhead, and the balloon was tossed to and fro between cloud and cloud, and set spinning round in a manner both bewildering and dangerous, and which reminds one of the well-known experiments in which pithballs are placed between oppositely electrified plates. That these oscillations were due to electrical attraction and repulsion seemed to be proved from the fact that a strong gale was blowing at the time, which could be felt in the car, and which the balloon did not therefore wholly obey. As a rule, an aeronaut scarcely feels the wind, however strong, since the balloon is carried along at the same rate. Neither M. Lecoq nor his companion felt any ill effects beyond the usual sense of oppression which accompanies such atmospheric conditions. There were no brush discharges visible upon the cordage of the car, but gusts of warm air were felt every now and then, which expanded the gas and carried the balloon further aloft. In one of these upward movements the balloon rose to a height of 1600 meters. At this altitude the storm attained its great intensity, constant discharges taking place between the cumulus in the middle of which the balloon was floating and a cirrus formation above it. M. Lecoq says: "I was particularly struck by the very violent agitation of the air and by the ascending and descending whirls which existed in the heart of the cloud, as well as the very strong attraction experienced by the balloon and light bodies floating in the air."

The above description confirms the existence of an electromotive intensity of great strength and subject to sudden changes of great magnitude during thunderstorms.

As soon as a discharge takes place the potential gradient at that point will be greatly changed and the point of discharge will become a region of low potential, in which direction the electromotive intensity will suddenly become very great, and the electricity will flow toward this point to increase the charge and restore equilibrium. When a discharge takes place, equilibrium is suddenly destroyed, and all objects are sharply impelled along the line of greatest electromotive intensity. This must result in sudden movements of the balloon, as a charge must be induced on it. This is confirmed by its attraction for light objects floating in the air. After each discharge there must be a complete and sudden readjustment to new conditions before equilibrium is restored. In the immediate vicinity of a heavy discharge, such as the position of the balloon in the above case, this effect must be very great.

As the distance between clouds is less than the distance to earth, their influence upon one another will be much greater and we will expect much more frequent discharges between them than between cloud and ground.

To summarize: There exists a potential gradient in the air. Under the influence of this gradient minute particles of vapor assume a potential and under the influence of the electromotive intensity they unite to form raindrops. When the raindrops have acquired a certain charge the potential becomes so great that the electricity escapes from the drops and passes to the outer surface of the cloud, as in a conductor, the charge is on the surface. Its escape from the drops and passage to the surface of the cloud is facilitated by the potential gradient and by the ultraviolet light from lightning flashes which take place in the vicinity and by the ionization of the air due to flashes. The charge distributes itself over the surface of the cloud, the distribution being modified by the presence of charges on other clouds—that is, by the potential gradient—and by the induced charge on the earth.

We will next study the surface of the earth considered as a conductor upon which charges are induced by the cloud charges.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Street Lighting Statistics.

By H. Thurston Owens.

The subject of street lighting, or public lighting, as it is sometimes called, is now receiving the attention which the subject demands, and the writer has been informed that the government intends issuing a report covering the year 1907, which will be much more comprehensive than any hitherto published.

There are more variables in street lighting data which affect the price than in service supplied to consumers, but in a report covering the whole country the items which it should reasonably contain are as follows: The number of each kind of lamp, the hours per year of burning, and the cost per year of each kind.

The government report for the year 1905 covered all cities of over 30,000 population, of which there were 154, and the various types of lamps were divided, as shown in Table I.

If the lamps were only divided into six types it would be an improvement to classify mantle vapor lamps separately and to place the open-flame vapor lamps in the same column with oil lamps, as the last named are of about equal value. The term "Welsbach" undoubtedly refers to mantle gas lamps, but a more equitable heading would be "Mantle Gas Lamps."

In the yearly report of the Boards of Gas and Electric Light Commissioners of the Commonwealth of Massachusetts the figures on street lighting are given by companies and the electric lamps are classified on a different basis from the gas lamps. The matter covering electric lamps is divided, as shown in Table II.

The information given covers a much greater scope than could be reasonably expected in a government report, and, in fact, could be somewhat simplified so as readily to admit of additions and, therefore, totals for the whole State which would be much more illuminating. The average daily number does not vary greatly from the total number in use and the number of hours per night and nights per month would be sufficiently indicated by the number of hours per year.

Lamps of various consumptions have similar nominal candle-power, so that the change from nominal candle-power to watts would only lead to a more confusing classification. Undoubtedly the average maximum candle-power would be still better, but just what these ratings are is still open to conjecture. The figures covering gas lamps in Massachusetts are presented as shown in Table III.

As no mention is made of the type or the cost, the data are only valuable for comparisons of company operations. The price paid is affected by so many variables that an average, even

if compiled for somewhat similar lamps, would not be a true indication of costs.

The matter of hours of lighting also varies considerably, as will be seen from the following data abstracted from the Massachusetts report for 1907:

LIGHTING SCHEDULES.

Private plants, gas and acetylene (not given)	—
Private plants, electric, all night	29
Private plants, electric, part all night and part half night	11
Private plants, electric, half night	110
Municipal plants, electric, all night	7
Municipal plants, electric, half night	16

TABLE I.—UNITED STATES GOVERNMENT, 1905.

City	Electric lights. Arc	Electric lights. Incandescent	Gas lights. Welsbach	Gas lights. other	Vapor lamps.	Oil lamps.
					—	—

TABLE II.—MASSACHUSETTS, 1907, ELECTRIC LAMPS.

Company	Number of public lamps	Nominal candle-power	Average daily number	Number of hours per night	Number of nights per month	Price paid

TABLE III.—MASSACHUSETTS, 1907, GAS LAMPS.

Company	Number of lamps supplied	Increase	Decrease	Price received per M, including expenses	Expense of lighting and care of lamps per M

TABLE IV.—PROPOSED FORM FOR GOVERNMENT REPORT.

	Electric lamps. Arc. Open.	Arc. Enclosed.	Incandescent. 25 cp and over	Incandescent. Under 25 cp	Lamps. Mantle, open flame	Oil, etc. Mantle, open flame	Total
City	2,000 1,200	2,000 1,200					

Following is the classification for electric lamps, including those used in street lighting, recently adopted by the Census Office, after consultation with leading officers of the National Electric Light Association and the managers of some of the larger central stations:

Class.	Type of lamp.
Arc lamps:	
Direct current	Open
	Enclosed
Alternating current	Open
	Enclosed
Incandescent lamps:	
Sixteen candle-power	
Thirty-two candle-power	
All other	
Other varieties [Nernst, vacuum, vapor, etc. (state kind)]	

In a report covering the whole country, the only totals which could be profitably compiled would be those covering the types of lamps, and Table IV is suggested in this connection.

The number of lamps should cover the number of posts and not the number of lanterns or globes. Costs per year should be given in a separate table under the same headings, and the hours of lighting per year in another, although they could perhaps be combined.

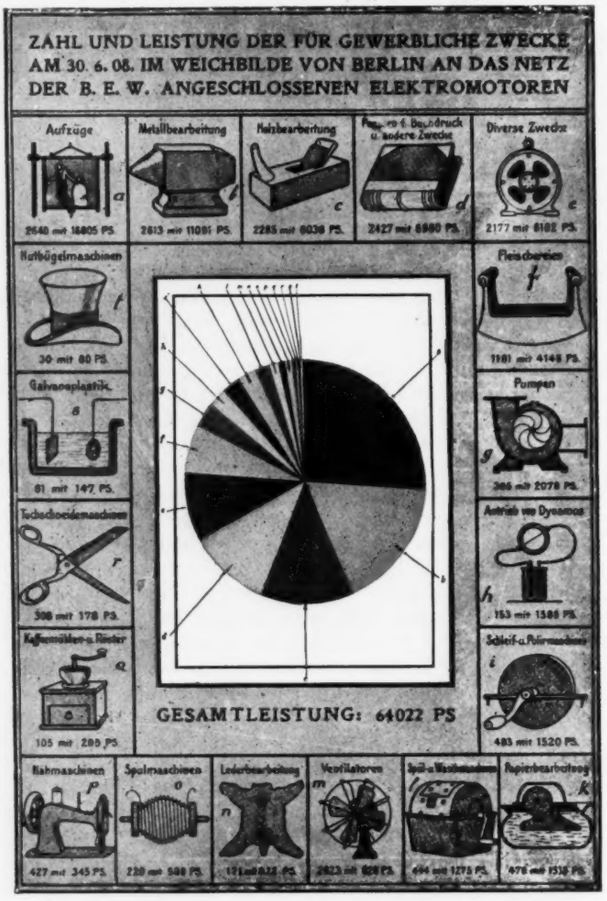
A Central-Station Traveling Man.

The past fall the Denver Gas & Electric Company, which has for some years been noted for its progressive commercial methods, made a move which is one of the first of its kind in central-station commercial practice. Early in the fall Mr. G. E. Williamson, the company's sign specialist, was sent on a trip East for the purpose of calling on a number of the concerns which do a large amount of national advertising and presenting to them the advantages of electric-sign advertising in Denver. Mr. Williamson also visited the larger Eastern central stations and learned as much as possible about recent Eastern ideas in novel and striking electric signs.

As a result of this trip, which is believed by the Denver company to be the first of the kind made by a central-station traveling representative, a number of good sign contracts with national advertisers are well on their way to being closed up. Another very satisfactory result of the trip is that by virtue of the new ideas gained by Mr. Williamson as to striking signs, contracts in Denver for seven large animated signs were closed before Jan. 1.

A Graphic Method of Showing the Application of Electric Motors in Berlin.

The Berlin Electrical Works, like some of the American central-station companies, publishes a monthly bulletin showing various applications of electricity for industrial, commercial and artistic purposes. In the December, 1908, number, it published a unique chart on which are shown a series of pictures symbolizing the purposes for which the company has furnished the amounts of power given in each picture. For instance, an anvil represents the metal industry. Under the anvil is given the amount of horse-power used in the business together with the number of motors. A pair of scissors serves to indicate the clothing or tailor industry; a hide, the leather industry; a book, the printing industry. These pictures form a border for a large multi-colored disk which is divided into



GRAPHIC ILLUSTRATION OF USES OF MOTORS IN BERLIN.

segments corresponding to the proportionate amount of electrical energy used for the purposes indicated. Each segment is identified by a letter opposite each of the symbols. It appears that, at the present time, the total amount of electrical energy sold by the Berlin Electrical Works for industrial purposes in 64,022 hp. The smallest item is made up of 30 motors whose combined capacity of 80 hp is applied for hat-ironing machines, and the largest of 2640 motors, with a total of 16,805 hp, for elevator service.

Central Station Rates.

A paper presented by Mr. R. S. Wallace at the annual meeting of the Illinois State Electric Association on "Rates and Their Relation to the Cost of Manufacture" is of value to those who have not followed the rate question closely for a number of years past, as it touches upon practically all the essential points to be considered. Mr. Wallace classifies fixed expenses as interest, taxation, insurance and depreciation, and the variable operating expenses as fuel, station labor, distribution labor, maintenance, supplies and general expense. He also calls attention to the fact that in specific instances some of these items which he classifies as variable are practically fixed. In a num-

ber of the smaller plants the item of station labor is practically fixed, because it would not be possible to operate the plant with less than one man on a shift. There is also a certain amount of fixed fuel loss connected with the operation of any central station, which loss is continuous as long as the plant is in operation. In making rates for business which does not come on the peak, the management of the small plant is apt to forget how little such non-peak business actually adds to the cost of running a plant, and consequently makes rates so high that the business is not obtained. Of course, non-peak users should bear a share of the cost of the service, but power used at non-peak periods is, to a certain extent, a by-product which can be sold at very low rates, in order to increase the total revenue of the plant, because it adds so little to the actual operating expenses. Below is an abstract of the paper by Mr. Wallace and of the discussion which followed the presentation.

The author states that he does not propose to present any new principles or ideas in reference to rates and their relation to cost, but will attempt to show that rates can and should be adjusted with reference to cost—not the average cost of all energy sold, but the particular cost of energy sold to consumers of various classes. That the cost of serving consumers of one class is different from that of serving another class has been recognized, although perhaps not generally, for over 25 years. That the principles involved are correct has been established in the courts and fully recognized by the commission. The following abstract is from a recent decision of the Wisconsin Commission:

"Short-hour users are more costly to the plant than long-hour users and consequently should pay higher rates. In fact, the instances are comparatively few where the short-hour users can be charged enough to cover the cost of carrying them." It has frequently been charged that differential rates based on load factor are discriminating and would be so held by the courts, but in the light of recent decisions it would seem that such views will be held only by those incapable of understanding the facts and many of the short-hour consumers.

The cost of generating electricity can be divided into two parts. The first is that incident to the use of capital and the second that incident to the operation of the plant in which the capital has been invested. Classifying the items of cost under their proper heads, we find in the first column what we will call fixed costs or constant expense, namely: Interest, taxes, insurance and depreciation. Under the second head, which we will call operating costs or variable expense, are the following items: Fuel, station labor, distribution labor, maintenance, supplies and general expense.

It is clear that the items of expense first enumerated, within reasonable limits, do not depend upon the amount of current generated, but are in proportion to the station capacity or connected load. The items given in the second list are nearly, if not exactly, proportional to the amount of current generated. If in specific instances any item in the second list is found to be fixed regardless of the amount of current generated, it should be transferred to the first list. It is possible also that the item of depreciation may vary slightly, depending upon the amount of current generated, but ordinarily it may be considered a fixed expense. The items of constant or fixed expense are proportional to the connected load or the maximum demand created thereby, and therefore each unit of connected load or maximum demand should be charged with its pro rata share of the fixed expense created, and likewise the variable expense being proportional to the amount of current generated each unit of current must be charged with a pro rata share of the variable expense.

Let us assume for the sake of illustration that for each kilowatt of load connected to a given station there has been expended $200 for the installation of station, lines, meters and other equipment. We will also assume that the investment costs are for interest, 5 per cent; taxes and insurance, 2 per cent; depreciation, 6 per cent; making a total of 13 per cent.

The annual fixed expense is, therefore, $26 for each kilowatt of connected load, and we should receive $26 per annum for each kilowatt connected, plus an amount sufficient to cover the variable expense incident to supplying current. Assuming that the variable expense is 3 cents for each kw-hour delivered, the total cost of current supplied to a consumer who uses his total connected load 365 hours per year, or one hour per day, will be 10.1 cents per kw-hour. If his use of current extends to two hours per day the cost will be 6.5 cents, and if three hours will be 5.4 cents per kw-hour, etc. The costs assumed as the basis of these figures are, of course, arbitrary and are used merely to illustrate the application of the principle. Theoretically, to arrive at a rate which will include a profit, the constant expense portion of the cost should be increased by an amount sufficient to pay the desired rate of dividend, but in practice it is better to divide the profit between the two portions of the rate. The first or constant expense portion of the rate will be designated as the standing charge and the variable expense portion the running charge.

Countless rate schemes have been devised with the principles outlined as a basis. Among those best known are the Wright "maximum-demand" rate, the so-called "multiple rate" and the Doherty "readiness-to-serve" rate.

The Wright maximum-demand rate was devised to overcome certain objections to the "readiness-to-serve" rate and requires the use of a demand meter in addition to the ordinary wattmeter for each consumer. This meter registers the maximum amount of current used at one time or the maximum demand created by the consumer's lamps and appliances. The maximum-demand meter is read and set back to zero each month by the regular meter reader, the reading obtained being used in computing the consumer's bill. Usually the consumer is required to pay a high (primary) rate, say, 15 cents per kw-hour, for 30 hour's (one hour daily) use of the amount of current indicated by the demand meter. All current used in excess of 30 times the maximum kw-hours is charged at a lower (secondary) rate, say, 5 cents per kw-hour.

Thus the consumer automatically fixes his rate on the basis of the demand he has made upon the system and the length of time he has used it, which is an equitable basis in that he pays for service in proportion to its cost. The high-rate portion of his bill covers the standing charge plus the running charge necessary to cover the current included in this portion of the bill, and the low rate portion covers only a running charge, all standing charges incident to the demand indicated having been covered by the high-rate portion of the bill. To illustrate the scheme, we will assume that the meter reader reports the maximum meter indication as 1 kw and the wattmeter registration as 60 kw-hours (two hours daily use of maximum). Applying the rates stated, we find the amount of the bill as follows:

30 × 1 kw = 30 kw-hours, at 15 cents	$4.50
Current in excess of 30 kw-hour, or 30 kw-hour, at 5 cents	1.50
	$6.00

Average rate per kw-hour, 10 cents. Had this consumer used 150 kw-hours, equal to five hours' use daily, instead of 60, his bill would have been $10.50 at an average rate of 7 cents per kw-hour.

The objections to this system of rates are the expense of installing and maintaining the demand meters, the possibility of a consumer creating a demand and then using a very small amount of current, thus not paying the cost incident to the demand he has created. This objection is of special importance when the maximum rate fixed by law or otherwise is comparatively low, say, 10 cents, as the number of hours' use of the maximum must be made greater than where the rate is higher, thus increasing the number of consumers who do not use their maximum the specified number of hours, and therefore do not pay adequately for the service they receive.

In case where the demand is equal to the connected load, such as signs, window and display lighting, demand meters are unnecessary, and if such lights are burned only during specified hours a straight meter rate can be computed which will be equivalent to that resulting from the application of the demand-meter rate.

There is a further objection to this scheme in that the demand is measured every month in the year, whereas it is the annual peak or maximum demand on the system which determines the fixed expense. However, the objections mentioned have not proved at all serious in practice, and the scheme as applied by many companies has worked out admirably.

The multiple-rate scheme is similar to the one just described, except that the connected load is substituted for the maximum demand as indicated by the maximum-demand meter. Thus the consumer who had 20 50-watt lamps connected would pay the rate for 30 hours' use of 1 kw, or 30 kw-hours, and the low rate for current in excess of that amount. Obviously if the full connected load is the basis used, the high rate per kilowatt should be less than in the example previously stated, or the number of hours' use required at the high rate should be less to produce equal results. Although 30 hours are the usual number, less than 30 being seldom used, it would seem better policy to reduce the number of hours rather than the rate, and thus limit the number of consumers who are short. In some instances where this rate scheme is used a fixed percentage of the connected load is taken as the basis instead of the entire load, but the percentage varies as between different classes of consumers, such as residences, stores, saloons, etc. The objections to this scheme are the difficulty of knowing what each consumer's connected load is, and what additions are from time to time made thereto. A further objection is that it discourages the liberal installation of lamps; but there are two sides to this argument, for if it discourages decorative lighting for use at Christmas time only, it is a good thing. This objection loses most of its weight if, instead of basing the rate on the entire connected load or a fixed percentage thereof, only the lamps installed in specified rooms, as parlor, living room, dining room, etc., are counted, leaving out the lamps usually installed for convenience rather than use in closets, stairways, basement, etc.

Under the Doherty "readiness-to-serve" scheme the consumer pays a fixed charge which is in proportion to the size of his installation, and an additional charge of, say, $1 per month, which is the same for all consumers. The fixed charge covers the items of constant expense as enumerated above and is the standing charge, while the $1 charge covers the expense of handling the consumer's account, meter expense and other items which are more nearly proportional to the number of consumers served than to the amount of current supplied or the load connected.

To the standing charge of from $24 to $40 per year per kilowatt connected, which may vary in different localities, is added, say, $12 per year per consumer, and, say, 5 cents per kw-hour as registered by meter. Although bills are rendered monthly, a rate of this kind is essentially applicable to annual contracts alone, for it is obvious that a consumer could not be carried through the month of December only for one-twelfth of the annual fixed charge without loss.

To illustrate the application of this rate, assume that a consumer has 20 50-watt lamps connected, and the meter indicates that 60 kw-hours (one hour daily) have been used, the monthly bill will then be at the minimum rate above.

Standing charge	$2.00
Consumer charge	1.00
Running charge, 60 kw-hour, at 5 cents	3.00
	$6.00

The average rate is 10 cents per kw-hour. Had the meter registered 150 kw-hours, which is equivalent to five hours' use per day, the bill would have been $10.50, or an average rate of 7 cents per kw-hour. This rate obviously distributes the standing charge in direct proportion to the fixed expense whatever may be the load factor.

The objections to this scheme are that it may discourage the liberal installation of lamps and that consumers occasionally object to paying a specific amount per month, whether they use much or little current. An argument sometimes used with prospective consumers, especially power consumers, is that central-station service permits them to adjust their expense in proportion to the amount of business done, but this rate scheme does not admit of using this argument. The fixed expense goes on just as if the consumer generated his own energy.

The one argument most frequently urged against all of the so-called demand-rate schemes is that so few consumers can understand them, but the very general adoption of such rates by central stations seems to indicate that this objection is not so important as many may have been led to believe. Numerous modifications of the scheme outlined have been devised, some perhaps for the sake of simplicity, but many for the purpose of adapting the scheme to assumed local conditions or the notions of the inventor.

Having established a rate on the basis outlined, whether it be according to one scheme or another, it may be modified to meet special conditions which arise from time to time, provided such modifications do not change the basic rates; in other words, each consumer pays the rate to which his load factor entitles him under the established rate regardless of the manner in which his bill is computed. For instance, a case may arise in which a consumer objects to paying a standing charge monthly, but will not object to guaranteeing a minimum use of current per year with a specified demand at a fixed price per kw-hour. It frequently happens in such cases that a consumer's annual load factor can be estimated very closely and a satisfactory contract made on such a basis.

It is common practice to allow a discount from the low rate or running charge portion of the bill if the bill exceeds specified amounts, the rate of discount increasing as the bill increases. This is a concession to the large consumer which is justifiable if the concession does not exceed unreasonably the difference in the cost of serving the large consumer as compared with the smaller. Lower rates are regularly made to large consumers than to smaller, regardless of load factor, and are seldom questioned; but there is no equitable reason for such concession beyond that warranted by lesser cost of service, although it is a general opinion that the courts would sustain them on the grounds of competition, either actual or possible.

The sliding scale of discount for quantity rates is seldom questioned, although a less equitable scheme, especially as applied to sales of electricity, could not be devised. This is the time-honored and accepted scheme of water rates, which perhaps accounts for its being tolerated so generally when applied to central-station service. A moment's consideration of the sliding scale is enough to condemn it. It places a premium on wastefulness. It is impossible to devise a schedule which does not at every step offer an opportunity to consumers to get more energy for less money.

The mention of water rates suggests flat rates, which are perhaps deserving of a moment's attention. Since the advent of satisfactory wattmeters, flat rates have practically disappeared, except in special cases. They are used in small towns for installations of a few lights where the expense of meter installations and maintenance is considered too great. Electricity generated by water power is frequently sold at flat rates to mills and factories, the charge being based on the maximum demand and a specified number of hours' use per day. Flat rates for sign and window lighting are daily coming into more general use, and are based on the prevailing meter rates with specified load and hours of burning, the switching being controlled by the central station.

Referring again to the demand-rate schemes, it is general practice to reduce the secondary rate as the load factor improves; in fact, the multiple-rate schemes sometimes cover 8 or 10 secondary rates, each applying to a specific portion of the energy used. Usually power and light are sold on different schedules, the rates for power being generally the lower, as is customary when applying straight meter rates. Rates for power may reasonably and equitably be lower than for light because of the generally better load factor, and the fact also that the demand made on the station is not necessarily coincident with the annual peak, whereas with light it is quite certain to coincide. The diversity factor is greater with motor load than light. Special rates are sometimes made for motor load

which is entirely off the peak, and there is no doubt that such rates can be made equitable, but, excepting rare cases, satisfactory contracts are difficult to arrange. Switchboard sales, or what may be called sales of "raw product," are generally made under special rates. "Special rates," a phrase that should be eliminated from the rate-maker's vocabulary in dealing with the public, as here used refers to rates made for service rendered under extraordinary conditions which are not covered by the established rate schedules. The public generally has little faith in rate schedules and believes, through misconception and the failure of central stations to adopt equitable standards, that each consumer's rate is the measure of his ability to drive a good bargain.

In conclusion, we should remember that the charge for service rendered should bear some relation to the cost of rendering it. That the straight meter rates cannot possibly approximate the cost of service. That differential rates have been held equitable and legal in many decisions, and should be required where the difference in the cost of supply exists. That as public servants we must not favor one at the expense of another; that we must not sell to one at less cost and make good our loss by excessive profits from another. That while fully realizing the importance of acquiring and retaining the approval and confidence of the public, we must not for the sake of it sacrifice the basic principles which we know are essential to success, because there is public demand for something else.

DISCUSSION.

In the discussion of Mr. Wallace's paper, Mr. William L. Clarke, of Paris, thought that the lighting schedule of charges in use in his own town was exactly what was characterized by the speaker as the most inequitable thing that could be devised. In self-justification he said that he did not devise it. Where he had devised rates they had been based upon the number of hours' use per day and he thought this the only equitable plan.

Mr. Frank J. Baker, of the North Shore Electric Company, said that a great many electric-light companies had taken the easy business which they may have thought was the profitable business because they obtained a comparatively high rate for it, but which is, as a matter of fact, the most unprofitable business they could take. It is now necessary to take the business which requires lower rates and yet be able to make that low rate in a manner which is subject to explanation and legal defence, if necessary. It is difficult to disturb rates which have been existing for years, but opportunities present themselves in new customers and especially in the power business. The salvation of an electric light company in a small town is in a 24-hour service and power business. In regard to the Doherty rate, in which there is a fixed charge per horse-power on motors installed, Mr. Baker said that one of the strongest arguments made to the manufacturer on electric power is that its cost will go up and down in the same manner as his own cost of production. A manufacturer does not like to tie himself up to a fixed charge which he will have to meet whether he has good business or poor business. His company has a power rate of 10 cents per kw-hour for the first 30 hours' use per month of the connected load; five cents for the second 30 hours' use of the connected load and three cents for the third and all continuing hours' use.

Mr. Kingman said that a scientific way of selling energy is the only way. The great difficulty is to show customers and have them see that the method is just and equitable. It is here that we will get benefit from regulating commissioners. When a commission shows that a rate is just, equitable and based on scientific principles, companies will be able to get closer to the public. Otherwise, the public might feel skeptical.

Mr. Clarke, of Paris, spoke of the possibility of making a lower rate for power business which will not be on during lighting hours. He spoke of a 45-hp motor in a grist mill on a contract of this kind, the owner of the mill of his own volition shutting the mill down before dark. In case he wants to operate longer hours, he starts a night shift after 11 p. m. The rate on this customer is two cents per kw-hour, with a minimum bill of $45 per month. The central station operates an exhaust heating system and obtains coal for $1 per ton, delivered.

Mr. Frank J. Baker also called attention to certain industries which cannot by any possibility operate during lighting hours. For example, stone quarries not equipped with artificial light. Practically every stone quarry within 30 miles of Chicago is at present figuring on equipping with electric power. His company has one customer of this kind taking 400 hp, and is figuring with four others. The question of using electric power for stone quarries he believes could be called settled. Mr. Wallace called attention to the fact that brickyards are usually on the non-peak class also.

INTERIOR WIRING AND ILLUMINATION

Wiring a Finished Dwelling Without Defacement.

There have appeared in these columns from time to time articles on the wiring of old buildings, particularly with reference to minimizing the amount of cutting and the damage to decorations, etc. The number of new buildings in a city bears no comparison with the number of old buildings, and the latter are near existing street circuits, which is not always the case with new dwellings. To be sure, there is no hope of installing electric lamps in many of the old buildings; but in a large percentage of these electric circuits could be installed were it not for excessive first cost in many instances, coupled with the dam-

FIG. 1.—BASE RECEPTACLES AND BRACKET OUTLET IN DRAWING ROOM.

age to ceilings and walls oftentimes attending the installation of wires. With reference to the high first cost of installation, it might be said that there are many contractors who have made a specialty of wiring old buildings and who have succeeded in many cases in bringing down the cost of wiring such structures to a figure only slightly in excess of what it would have cost to wire the building when new. The cost is somewhat greater in wiring a building with a view to minimizng the damage to walls and decorations, since much more wire and labor are required in getting around obstructions, which would not have to

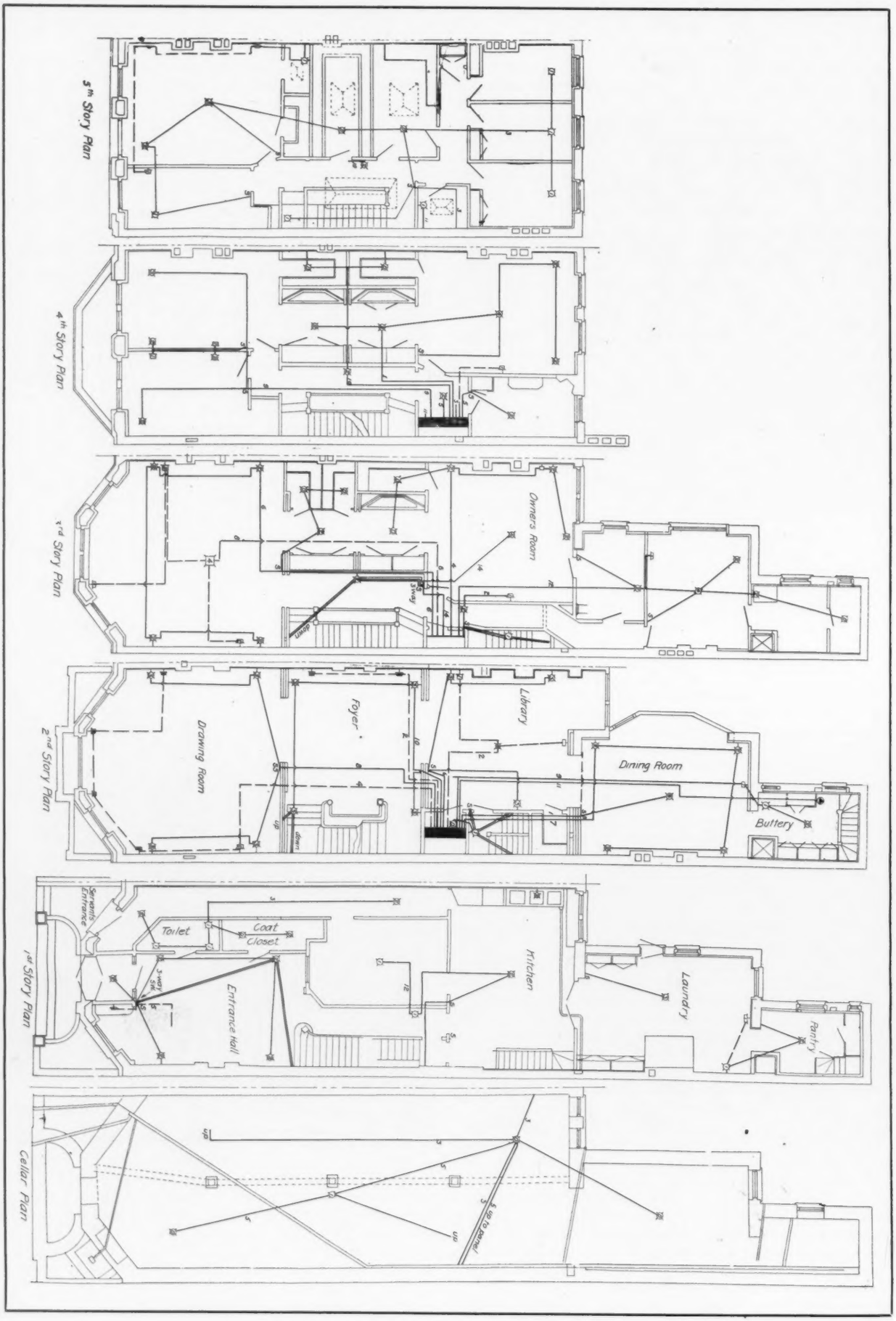


FIG. 2.—WIRING DIAGRAMS OF THE VARIOUS FLOORS.

be wired around were cutting and patching permissible or if the building were being erected.

An excellent example of a house wired from top to bottom without damage to walls, ceilings or decorations is given in the Colgate residence on West Seventy-sixth Street, New York City.

FIG. 3.—SWITCHES IN HARDWOOD WAINSCOT OF DINING-ROOM

This is a five-story dwelling located in one of the most fashionable sections of the city, and the work of wiring it was entrusted to Messrs. Peet and Powers, of New York. There are in the neighborhood of 150 outlets in the ceilings, walls, baseboards and floors, and one ignorant of the actual conditions could not but believe that the dwelling was wired when it was erected. That the installation of the wires under the stipulations was not an easy task may be inferred from the plan view of the various floors shown in Fig. 2; but that the work did meet the conditions of sparing the walls, ceilings and woodwork from

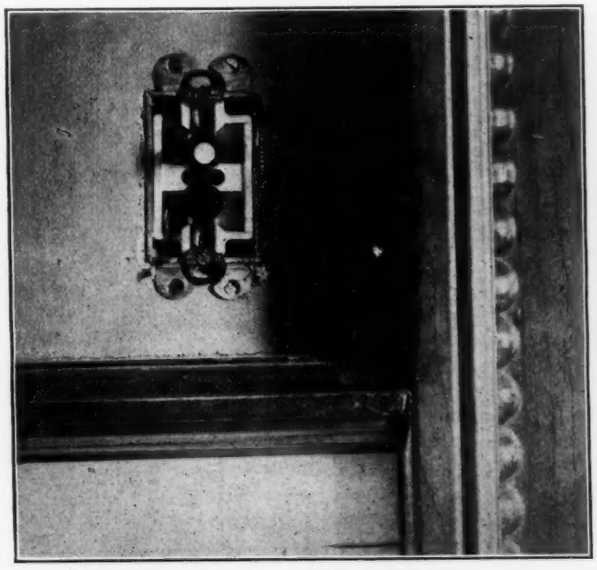


FIG. 4.—SWITCH IN OWNER'S BATHROOM.

damage and defacement is evident from the various views shown herewith.

The energy for the lamps is taken from the underground street mains of the local electric light company. Two panels are provided, one on the second floor which controls the circuits in the cellar, first floor and second floor; and one on the fourth floor which controls the circuits on that floor and the floors immediately above and below it. The panels are placed in closets at the head of the stairways and flexible armored cable was used throughout in wiring. The house has furring strips between the lath and timbers and between the lath and walls so that fishing from pocket to pocket in floors was rendered easy. In the diagram the various circuits are numbered, and with few exceptions there are 12 lamps on a circuit. In placing the base receptacles, switch boxes, etc., holes were cut just large enough for the box in each instance, and the wires were fished from outlet to outlet in many cases, and from outlet to pockets, and from the latter to other pockets or to switch boxes, etc., as the case might be.

Fig. 1 is a view of the drawing-room, in which four three-lamp brackets and five two-lamp base receptacles are installed. These are fed from circuits No. 8 and No. 4, respectively, and the bracket lamps are controlled from switches on the jamb of the rolling doors leading into the room. The base receptacles are wired from the floor, a pocket being taken up under the receptacle and a number of pockets made in the floor to facilitate the installation of the cable. The illustration shows the fish wire and cable pulled from a pocket cut to wire the lamps in the ceiling outlet in the entrance hall of the floor below. The bracket lamps in this room are also wired from the floor below, the outlet being first set and the wires fished. The circuit runs from the panel board on that floor to the switches, being placed under the floor and brought up between the partition in which the doors roll to the switch outlets. From here the circuit descends to the floor again, running between the lath and timbers to a pocket and thence over between timbers to a pocket under the bracket whence it is fished to the outlet. The drawing room is elaborately decorated and the illustration shows that the only defacement were the pockets in the hardwood floor. The pockets were made very small, and the wood was fitted in place again by a carpenter so as to leave no trace when the spot was refinished. The fixtures, of course, covered the boxes for the bracket lamps, and the plates for the base receptacles obscured the outlets for the latter. There are no ceiling outlets in the drawing room.

Fig. 3 shows the outlets in the hardwood wainscot for the switches controlling the lamps in the dining-room. The bracket lamps are fed from circuit No. 7, and the ceiling outlet for six lamps is fed from circuit No. 1, which also supplies energy to

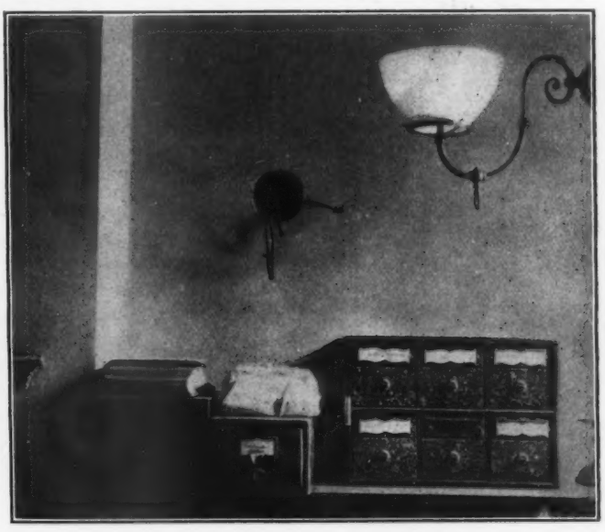


FIG. 5.—BRACKET OUTLET IN OWNER'S BEDROOM.

lamps in the kitchen on the floor below. A special circuit, No. 11, is run from the panel board to an outlet in the pantry back of the dining-room for heating circuits. The base receptacles in the foyer hall are connected to circuit No. 2. The brackets, base receptacles and floor receptacles in the library are fed from circuit No. 6. Circuit No. 9 runs to the pantry back of the dining-room and thence down to the bracket in the kitchen on the

floor below and to a ceiling outlet in the passage in the rear of the kitchen. A base receptacle in the dining-room and another in the kitchen are also connected to this circuit. The entrance hall brackets are connected to circuit No. 5 and the brackets in the foyer hall are fed from circuit No. 10. There are 12 circuits in all which are fed from the panel board on the second floor.

Fourteen circuits run from the panel board on the fourth floor, one circuit being left blank. There is nothing special in the wiring of these floors except that some very fine instances of fishing from outlet to outlet are shown. The bathroom adjoining the owner's chamber is fitted with tile wainscot and tile floor. The roof being directly overhead, it was necessary to fish up from the switch outlet, shown in Fig. 4, to the two-lamp bracket outlet on the wall opposite. The circuits in the bedroom and bath to the rear of this bathroom were similarly fished, there being no hanging ceiling overhead, and it being out of the question to cut the roof. The switch circuit to the two-lamp bracket does not run from the door jamb indicated, but from the other side of the door near the wash basin, so that the fish wires were manipulated in the same vertical plane and not at an angle as the engraving would indicate. The setting of the switch box is admirably shown in Fig. 4. The engraving also

FIG. 6.—CEILING OUTLETS IN BEDROOM.

illustrates with what nicety the wall was cut and the box set. The switch plate covers the box in a manner leaving nothing to be desired so far as finished appearance is concerned. Fig. 5 also shows how a decorated wall in the owner's chamber was cut and the bracket outlet installed. The box fits exactly and one would be justified in imagining that the wall was decorated after the box was installed, but such was not the case. A view of the large front bedroom on the fifth floor is shown in Fig. 6. In the ceiling of this room are a center chandelier outlet and a two-lamp outlet directly over where a dresser will be placed. The plan view shows how these circuits are run and the photographic view shows that the ceiling was not cracked or marred by the installation of the electric circuits.

The entire installation is a model of its kind. The owner being a wealthy man, expense did not figure to a very great extent, although there was no waste of time nor was the price per outlet excessive for the work performed. The dwelling is elaborately furnished and decorated, and while good workmanship was required in running the circuits and setting the outlets, etc., the nature of the work was such that any first-class wireman could have undertaken and finished it in the same manner.

New Telephone Patents.

TELEPHONE RECEIVER.

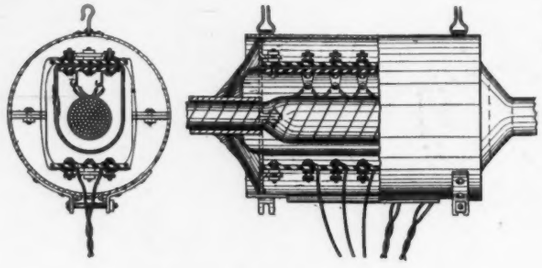
In the telephone receivers heretofore manufactured, the diaphragm has been so positioned with regard to the field as to be continually under strain due to the pull of the field. In some instruments the diaphragm has even been initially dished against this pull. In a receiver invented by Mr. N. Baldwin, of Heber, Utah, the normal fields are balanced, in so far as concerns any action across the plain of the diaphragm. To accomplish this result the soft iron pole pieces are U-shaped and the edge of the diaphragm lies between the two legs. The base of each leg is attached to its own pole of the polarizing permanent magnet, thus the pull from the pole pieces is practically nil across the diaphragm, as the opposing pole faces are of the same polarity. The receiver windings are carried by the legs of the U-shaped pole pieces, and are so arranged that the telephone current augments one pole and decreases the other to cause the response of the diaphragm. This change takes place at both pole pieces simultaneously and in such a manner that the two poles assist each other in causing vibration of the diaphragm.

ADJUSTABLE DROP.

Mr. E. E. Yaxley, of Chicago, has been granted a patent for an improved adjustable drop. The drop is arranged with a tubular shield and the armature is presented to the front or mounting end of the coil. This arrangement enables the coil or any replacing coils to be slipped in freely from the rear. Coils are secured by a pin and slot having the form of a bayonet catch. The coil cores are bored out to form a receptacle for a spiral spring, opposed to the armature's action and adjustable from the rear by a screw driving down upon the rear end of the spiral spring, and transmitting its pressure against the motion of the armature, thereby effecting an adjustment. The Monarch Telephone Manufacturing Company has obtained this patent by assignment.

CABLE TERMINAL.

A new form of cable terminal for aerial use is shown in the accompanying illustration. This terminal is designed for mounting directly in the cable, so to speak, and to afford terminals for a multiple tap. A glance at the sectional portion of



M'MEEN CABLE TERMINAL.

the drawing shows just how the lead sheath is sealed into the terminal, how the wires are attached to the terminals in the sealing cover, etc. The terminal is provided with hooks for its support from the messenger. Mr. J. E. McMeen, of Galesburg, Ill., is the inventor of this terminal.

ANTISEPTIC DEVICE.

A patent granted to T. M. La Jord, of New York City, describes an antiseptic device of rather novel construction. A piece of fairly stiff cardboard is punched out in special form and then by folding is made into an antiseptic container adapted to clamp itself over the transmitter mouthpiece. The cardboard when folded is square; when cut it becomes a cross. Thus, to make the square, the four arms of the cross are folded back upon the center. The edges of the flaps thus made are cut to form a circle somewhat smaller than the transmitter mouthpiece and they are held together by an elastic band caught in notches in their edges. A window is cut in the center of the

cross. The antiseptic screen is placed behind this window. In use, the flaps are sprung over the mouthpiece and the pressure of the elastic band holds the device in position.

FIRE-ALARM ATTACHMENT.

G. F. Milliken, of Boston, and F. W. Cole, of Newton, Mass., have jointly patented a combined automatic fire alarm, burglar alarm and telephone system. Through the agency of special relays and interrupters, the alarm contacts are made to superimpose upon the telephone system distinctive signals to indicate the class of danger existing in any emergency.

LETTER TO THE EDITORS.

The Electromagnetic Gun.

To the Editors of Electrical World:

SIRS:—In all of the criticisms of the electromagnetic gun I have yet to find one that considers the possibilities of the flywheel. For example, a 10-kw motor in 15 minutes could store up in a flywheel 9000 kw-seconds of energy—equal to 6,640,000 ft.-lb. A flywheel having a weight of 21¼ tons would store this amount of energy at a velocity of 100 ft. per second on its circumference of gyration. Suppose, that on the shaft of the flywheel there were placed a generator of small resistance and compensated inductance. If the circuit of this generator were suddenly closed through proper solenoids it should be able to furnish a speed of 2000 ft. per second to a projectile weighing 106 lb., assuming no losses. The length of gun required would depend on the inductance and resistance of the electric path, which determines the time-constant—the time in which the current would rise to a value equal to $0.632\,E \div R$—if the impressed voltage were kept constant. The impressed voltage in this case would not be constant because the flywheel must decrease in speed in order to give off its stored energy. The inductance effect could, of course, be partly cut down by capacity. The details of this effulgent device can be worked out by those who have the time—and the courage.

CHICAGO, ILL. H. S. QUACKENBUSH, JR.

[An outfit consisting of a 10-kw motor, a 21-ton flywheel having a peripheral velocity of 7000 ft. per minute, coupled to a generator (the size of which our correspondent neglects to specify) capable of transferring the energy from the flywheel at the instantaneous rate of, say, 18,000 kw to an electromagnetic gun 500 ft. in length, or 180,000 kw to a gun 50 ft. long, could hardly be considered a commercial competitor to a self-contained gun of the time-honored type 25 ft. in length weighing less than 10 tons, and requiring a charge of powder weighing 42 lb.—EDS.]

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Brush for Rectifiers.—A note on a British patent (25,624) of M. Walker for the construction of a brush for commutators and rectifiers or "permutators." To prevent sparking, the collecting brushes are moved into such a position relatively to the magnetic field that the e.m.f. produced in the short-circuited coil is sufficient to entirely reverse the current. If the e.m.f. is too large, however, "over-commutation" will occur, as the reverse current will be larger than the armature current. To prevent this action the inventor employs a double brush, between the two halves of which an "electric valve" is placed. The valve thus prevents the current from reversing, while the coil is short-circuited.—Lond. *Elec. Eng'ing*, Dec. 17.

Lamps and Lighting.

Regulation of Arc Lamps.—J. TEICHMÜLLER.—The first part of an illustrated paper in which the author endeavors to give an exact explanation of the principles which determine the regulation of arc lamps with inclined electrodes, placed side by side, and with an electromagnet for deviating the arc. The usual explanations of the regulation of arc lamps assume electrodes of ideal uniformity and with a perfectly steady arc. The author's theory takes into account the disturbances which are always present in practice. The paper is to be concluded.—*Elek. Zeit.*, Dec. 17.

Filaments from Refractory Oxides.—A note on a British patent (25,655) of E. von Seemen, for making conducting filaments from such oxides as alumina, silica, lime, magnesia, or compounds of these. This result is accomplished by fusing these materials with a small quantity of an oxide of the iron group in the presence of oxygen. A filament, made of, for instance, from 85 per cent to 90 per cent of magnesia, alumina or silicate of magnesia, with from 15 per cent to 10 per cent of iron or chromium oxide, is a good conductor.—Lond. *Elec. Eng'ing*, Dec. 17.

Generation, Transmission and Distribution.

Electric Winding in Mines.—G. HOOGHWINKEL.—A note on a paper describing the electrical winding system used at the Maritime pit of the Great Western Colliery Company. This is the first electrical winding engine of moderate capacity at work in South Wales, and for that matter in the United Kingdom, being required to wind 175 tons of coal per hour from a depth of 1110 ft. in 70 winds. Given favorable conditions as to loads, depth and, above all, banking conditions, combined with a low price for electrical energy, it could be shown that electric winding could be performed, at least as safely as, and at no greater cost than, with steam. Among the points which had altered the conditions in favor of electric winding might be mentioned the increasing value of small coal in South Wales and the decreased cost of electric energy. It was a controversial point as to the price at which energy could be supplied, but he claimed to have obtained figures varying between 0.5 cent and 0.8 cent per kw-hour, including 10 per cent for interest and depreciation with colliery power stations varying between 1000 kw and 5000 kw installed, using coal at $2 per ton. Electricity supply company figures were generally somewhat higher, but they might be expected to come down to the figures stated in the course of time. As regards the winder under notice, the Westinghouse system was adopted, whereby a three-phase motor was used capable of receiving energy directly from the mains. The absence of recuperative energy with this system was met by an ingeniously designed drum, which, if properly handled, stopped without any braking being required after the current was cut off. The plant had been in continual use for about four months, and the engine had proved to be easily able to deal with the requirements. The cost of winding at one trial was brought down well under 4.46 cents per ton, which steam winding would have cost.—Lond. *Elec. Review*, Dec. 11.

Coal.—W. JONES.—An article giving some fundamental considerations on coal. In selecting coal it is necessary to consider the work for which it is intended; the coal of the highest heating value is not always the best for every purpose. To burn coal successfully the furnace must be designed according to the nature of the coal. In operation it is important to make frequent analyses of the gases in the flue. In the case of soft coal there should be from 14 per cent to 15 per cent of CO_2.—*Electrochem. and Met. Ind.*, January.

Water Power in Australia.—E. K. SCOTT.—The author gives data on some hydro-electric installations in Australia; 1300 hp have been developed at Launceston, Tasmania; 3300 hp at Waipori, Dunedin, New Zealand, and 250 hp at Hillgrove, New South Wales. In general, however, Australia is singularly lacking in natural water power. It is shown, however, that it offers exceptional opportunities for impounding water by erec-

tion of dams both for irrigation and power purposes.—Lond. *Elec. Engineer,* Dec. 11.

Superheat.—J. P. Fletcher.—The author discusses the relative advantages and disadvantages of integral and separately fired superheaters. He is strongly in favor of the integral system.—Lond. *Elec. Engineer,* Dec. 11.

Producer Gas.—O. Nagel.—An illustrated article describing several furnaces for operation with producer gas for use in chemical and metallurgical industries.—*Electrochem. and Met. Ind.,* January.

Traction.

Regenerative Braking with Series Motors.—A note on a British patent (22,868) of the British Thomson-Houston Company for regenerative braking with direct-current series motors. The armature and the field circuits of each motor are connected in series as usual, but the voltage across the field coils is varied by means of a special source of supply. In this way a definite speed is fixed, below which the machine runs as a motor, and above which it runs as a generator; in each case the machine runs with a series speed-torque characteristic. To supply the extra field excitation, a homopolar machine, with a set of collector rings for each motor, is provided. Series-parallel control of the motors is possible, as usual.—Lond. *Elec. Eng'ing,* Dec. 17.

Suspended Railways for Industrial Plants.—Von Harffstengel.—An illustrated paper on suspended electric railways (telpherage) for transmission of materials in industrial plants, especially in coke plants, metallurgical works, etc.—*Elek. Zeit.,* Dec. 17.

Installations, Systems and Appliances.

Electric Heating in Textile Plants.—Cremer-Chapé.—In textile works the cloth is pressed and simultaneously heated to get a smooth or bright surface. The author discusses the advantages of electric heating for this purpose and shows that this method is cheaper on account of saving of labor and also gives the best results.—*Elek. Zeit.,* Dec. 17.

Records of Mains.—J. W. Beauchamp.—An illustrated paper read before the Leeds section of the (Brit.) Inst. Elec. Eng. The author describes the methods of keeping records of the positions and nature of mains and services in use at Sheffield, and also proposes a more complete system. It involves a key map of the area, ordnance sheets and maps with indications of stations, feeders, etc., other diagrams, and card indexes and note books.—Lond. *Elec. Eng'ing,* Dec. 17.

Plate-Glass Switchboard.—An illustrated description of a plate-glass switchboard for the use of students, giving a complete view of the path taken by the electric current from the front and also showing the position of the switches from the back.—*Jour. of Elec.,* Dec. 19.

Wires, Wiring and Conduits.

Cheap House Wiring.—An article pointing out the dangers arising from the use of flexible cord wiring on walls. There is no objection to its use on ceilings, apart from esthetic considerations. But wires laid on the surfaces of walls need some kind of protection. "Some years ago a method of wiring in flexible metallic tubing was proposed. This is now slowly coming into use for motor wiring on machinery. . . . There are possibilities in this method for surface wiring in small properties. A good quality of flexible inside a small flexible tube would lend itself to quick work, and this metallic protection need only be used on walls, say, up to the cornice, where a multiple connection box would be fixed, from which the flexibles would start. Being metallic, the tube would need earthing. If there were a demand for it, a flexible fiber or papier-mâché tube could be made on the same lines as the flexible metallic tube, and such would be as safe as wood casing and much more easily and cheaply erected."—Lond. *Elec, Review,* Dec. 11.

Welding of Aluminum.—A note on a recent British patent (24,283) of M. U. Schoop on his process of welding aluminum, which consists in using a flux produced by adding fluorides of calcium, potassium or boron to a mixture of chlorides of alkali metals.—Lond. *Elec. Eng'ing,* Dec. 3.

Electrophysics and Magnetism.

Conductance.—An illustrated article giving formulas for finding the heat conductance and resistance of composite bodies. The problem is exactly analogous to that of finding the electric conductance of composite bodies consisting of several materials of different resistivity.—*Electrochem. and Met. Ind.,* January.

Selective Radiation from Various Solids.—W. W. Coblentz.—An illustrated account of an experimental investigation of the radiation from electrically heated solids, among them rods made from zirconium oxide, oligoclase, albite, orthoclase, beryl, rutile, porcelain, magnesia, glass, opatite and topaz. He also studied the emission spectra of various solids placed in the form of a paste upon a heater (Nernst "heater-tube"). Among the materials investigated in this way were zirconium oxide, cerium oxide, thorium oxide, and various other oxides and mixtures of oxides. In general the results on the oxides furnish an excellent illustration of the shifting of the maximum of intensity of emission toward the short wave lengths with rise in temperature, just as is known for metals which emit continuous spectra. In this respect the various emission curves of zirconium oxide are particularly conspicuous. In addition to what may be termed "general emission," in which the maximum shifts with rise in temperature, the curves of zirconium oxide are unique in having a sharp band of selective emission which neither shifts nor broadens with rise in temperature. Many of the oxides have an emission band in common in the region of 2.85 μ, and it is not impossible that this band be due to the oxygen atom which is in common with all of them. In a broad sense, the intensity and sharpness of the emission bands are a function of the electrical conductivity. The best insulators, e. g., the refractory silicates, the oxides of zirconium, erbium, etc., have the sharpest emission bands, while the better electrical conductors, such as the oxides of cerium, iron, zinc, etc., have a high emissivity but no sharp emission bands throughout the infra-red. The molecular weight of the base seems to affect the sharpness of the bands to as great an extent as does the electric conductivity.—*Bull. Bureau of Standards,* Vol. V, No. 2 (November).

Luminous Equivalent of Radiation.—P. G. Nutting.—A long theoretical paper in which the author endeavors "to establish a scientifically precise yet practically manageable relation between light and its sole measurable constituent, radiation."—*Bull. Bureau of Standards,* Vol. V, No. 2 (November).

Electrochemistry and Batteries.

Pump for Storage Battery Cleaning.—A description of a portable duplex pump, devised by F. Misling, for removing the

FIG. 1.—STORAGE BATTERY PUMP.

residue which collects at the bottom of accumulator cells, and at the same time filling in an equal volume of fresh acid. As shown in Fig. 1, it consists of two simple air pumps and two strong glass vessels, one for the residue and the other for the fresh acid. One pump compresses the air in the latter vessel,

the other pump exhausts the air from the former vessel. In neither case does the acid come into contact with the pump. The tube used for insertion into the cell is made of celluloid, and its shape can be readily altered by means of hot water so as to introduce it into any form of cell.—Lond. *Elec. Review,* Dec. 11.

Induction Furnace.—F. A. J. FITZGERALD.—An illustrated account of experiments on the efficiency of the induction furnace as a melting apparatus. The tests show the possibility of heating of the charge in the induction furnace very quickly. Curves give the variation of the kilowatts and of the power-factor during the experiment. The latter varied between 0.7 and 0.6. —*Electrochem. and Met. Ind.,* January.

Electric Steel Works.—J. W. RICHARDS.—An illustrated sketch of what is called the largest electric steel works, now being erected by the Girod Steel Company in Savoy. Twenty-two thousand hp of water power have already been developed. The furnace house contains at present two 2-ton furnaces and two 10-ton furnaces. The latter will be normally operated at from 8 tons to 12 tons charge, using energy at 60 volts and32,000 amp. The normal output of these is reckoned at 50 tons per day, but there is room and corresponding works capacity for four times as many furnaces, and an eventual output of 200 tons per day. The smaller furnaces are intended particularly for making special and high-price steels, the larger ones for carbon and nickel steels.—*Electrochem. and Met. Ind.,* January.

Electric Smelting of Iron Ore.—J. HARDEN.—An article in which the author considers the smelting of iron ore in the electric furnace in comparison with blast-furnace practice. The comparative figures given show the impossibility of the electric furnace competing with the blast furnace under average conditions.—*Electrochem. and Met. Ind.,* January.

Aluminum.—An illustrated description of three new British aluminum works of the Aluminum Corporation, Ltd., and of the British Aluminum Company. The new bauxite works of the Aluminum Corporation are also described.—*Electrochem. and Met. Ind.,* January.

Aluminum.—M. DE KAY THOMPSON.—An illustrated note on a laboratory experiment on the electrolytic reduction of aluminum. The effect especially studied was the covering of the graphite anode with a film of gas which interrupts the circuit. —*Electrochem. and Met. Ind.,* January.

Ozone.—A. W. EWELL.—A note on the thermal production of ozone giving a description of laboratory experiments.—*Electrochem. and Met. Ind.,* January.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—An illustrated description of the Bolt Head station of the British postoffice, near Kingsbridge, South Devon. It will give facilities for communication with ships at sea, under the provisions of the International Radiotelegraphic Convention. Most of the apparatus installed is of the latest Marconi pattern. When working, both the transmitting and receiving circuits are connected to the antenna, and the same operator can receive while transmitting. This has been rendered possible by the use of a small spark-gap inserted in the antenna, across which the receiving apparatus is connected. During transmission, the current surges bridge this gap, which is then practically non-existing. Means are provided for automatically short-circuiting the telephone when contact is made in the transmitting circuit. Another novel feature is the provision of variable couplings in the high-frequency oscillation transformers for the purpose of enabling sharper waves to be produced. The receiving apparatus includes the latest pattern of the Marconi multiple tuner. A mast, 160 ft. high, supports an umbrella-type antenna of stranded copper wire.—Lond. *Elec. Eng'ing,* Dec. 17.

Reflections of Waves on Telephone Lines.—F. BREISIG.—A mathematical paper, contributed from the German Telegraph Research Bureau. When a wave is transmitted over a telephone line, consisting of successive portions of different construction, then part of the wave is reflected at any joint where two different portions of the line are connected together. The author gives the fundamental formulas and discusses the following three cases, in which the line consists of two short different portions or of two long different portions or of a long and a short portion respectively. Under ordinary conditions of practice the reflections can be observed, but are hardly so detrimental as to require special provisions. In special cases, however, when loaded cables of the Pupin type are connected with overhead lines, it is to be recommended to make special provisions; otherwise unnecessary expense would be required for inductance coils, the effect of which would be counteracted in part by the reflections.—*Elek. Zeit.,* Dec. 17.

Units, Measurements and Instruments.

Fundamental Units.—F. A. WOLFF.—His complete paper on "the principles involved in the selection and definition of the fundamental electrical units to be proposed for international adoption." The paper deals chiefly with the question whether the ampere or the volt should be the second fundamental unit. In view of the preference indicated for the coulometer at recent conferences, the reproducibility of the cell and coulometer should first be definitely established by systematic international co-operation, which would also result in bringing to light unrecognized defects in the proposed specifications.—*Bull. Bureau of Standards,* Vol. V, No. 2 (November).

Weston Standard Cell.—F. A. WOLFF.—An account of an experimental investigation showing that Weston cells can be set up which exhibit extremely little hysteresis in the temperature range from 0 deg. to 40 deg. C., even when subjected to large and rapid temperature variations. Such cells maintain their e.m.f. values under prolonged heating or cooling. The relation between the e.m.f. E and the temperature t in degrees C. is best represented by the formula:

$$E_t = E_{20} - 0.00004075\,(t-20) - 0.000000944\,(t-20)^2 + 0.0000000098\,(t-20)^3$$

No indications were found of differences arising from the methods of preparation of the mercurous sulphate employed.—*Bull. Bureau of Standards,* Vol. V, No. 2 (November).

Electric Sounding Device.—A description of a simple sounding device of A. Schortau. As shown in Fig. 2, it consists of a chamber C, with corrugated walls, filled with mercury. Two resistor wires w and w_1 in a glass tube T dip into the mercury, and the whole is made watertight. The pressure of the water upon the flexible walls of the chamber drives the mercury up the tube to a distance depending upon the depth, thus short-circuiting a portion of the resistor wires and changing the resistance of the instrument. The resistance is measured on board ship, so that the depth is determined without hauling up the "lead." —Lond. *Elec. Review,* Dec. 11.

FIG. 2.—SOUNDING DEVICE.

Distributed Capacity of Resistor Coils.—S. L. BROWN.—The author refers to the recent attempt of Taylor and Williams to construct a resistor coil which would be free from inductance and capacity. This coil was made of No. 40 Advance wire, wound in a bifilar coil on a spool 12 cm in diameter. The wires were twisted together and consecutive turns were 5 mm apart. The twisting of the wires prevented the introduction of inductance by winding the wires into a coil. The separation of consecutive turns eliminated any measurable capacity that might be caused by the crowding of the wires into a compact coil. Therefore, the inductance and the capacity of such coil are reduced to the inductance and the capacity of the two wires lying side by side. Measurements which were made with this coil showed that the preponderance of either inductance or capacity was too small to be measured. The capacity was increased by immersing the coil in petroleum, thereby increasing the specific inductive capacity of the medium between the wires, and still no capacity could be detected. The presumption that the capacity due to the adjacent wires in the bifilar turns of an ordinary resistor coil is only a small fractional part of its total capacity seemed to be justified. Therefore it was concluded that the inductance and the capacity of this so-called ideal coil had been effectively reduced below

measurable quantities. The present author has constructed a similar coil and shows in this paper, both by the calculation and by experiment, that the coil is not free from capacity.—*Phys. Rev.*, December.

Terminal Apparatus in Telephonic Transmission.—L. Cohen.—A mathematical paper on the influence of terminal apparatus on telephonic transmission. In general, whatever influence the line may have in distorting a telephonic wave when the wave reaches the receiving instrument part of it will be reflected, and will merely dissipate itself on the line, and part will be absorbed and furnish the energy necessary to operate the instrument. Either portion of the wave, however, be it the part reflected or absorbed, is a function of the frequency, and therefore every harmonic is affected differently. This will necessarily produce a certain amount of distortion. The extent of the distortion that the wave will suffer in passing through the receiving instrument may under certain circumstances be considerable. The final expressions obtained by the author for the potential and current at the end of the line are of very simple form and convenient for numerical calculation of the distortion due to the terminal apparatus. In the case of a 30-km line it is found that the receiver increases the distortion, but that the introduction of a condenser will improve the transmission. There is considerable improvement possible in this direction. In the case of a 300-km line the receiver is found not to influence telephonic transmission materially—*Bull. Bureau of Standards*, Vol. V, No. 2 (November).

Wireless Telegraphy.—H. Poincaré.—His second lecture on the theory of wireless telegraphy. In the present installment the author deals with the study of the field in the neighborhood of the antenna.—*La Lumière Elec.*, Dec. 5.

Miscellaneous.

Switzerland.—Statistical tables on imports into and exports from Switzerland of electrical machinery and appliances in 1906 and 1907. The largest items are, of course, dynamo-electric machinery and transformers. The imports of 1907 had a value of $314,600, the exports $3,486,600.—Lond. *Elec. Rev.*, Dec. 11.

Continuity of Education.—F. P. Fish.—An address to the graduating class of the School of Mines of Columbia, pointing out that every graduate of a university should have the definite aim to continue his education throughout his life and should endeavor to broaden his interests in human affairs.—*School of Mines Quarterly*, November.

NEW APPARATUS AND APPLIANCES

Air Heater for Use with Live or Exhaust Steam, Hot or Cold Water, or Brine.

Air and water within the pipes are the bane of most steam air heater coils and radiators. It will be found that in many of them the steam is not forced to circulate positively through the coils, but can pass directly within the "header" casting from the inlet to the outlet without going through the pipes at all, and, contrary to the usual assumption, this very thing may happen if there is air in the pipes. The loops of pipe employed in such heaters, in fact, make nice air pockets. From an examination of the accompanying diagram showing the course of circulation in the Green steam air heater, it will be seen that the current of steam must flow straight ahead through half the tubes, then back through the other half down to the bottom outlet, driving before it any air that may be present. This is the natural direction of flow, since the air is heavier than the steam. With this heater, the preliminary "blowing out" sometimes practised for the removal of air is really effective. The heater, it is said, cannot become air-bound, and all of its surface is active in transmitting heat. Currents of steam and water are always in the same direction and, should water of condensation accumulate, it would be pushed through positively in the same manner that the air is pushed through, as before described. This positive circulation principle enables the steam heater to be used as a hot-water heater, or as an air cooler, since hot water, cold water or cold brine can be circulated continuously through the pipes and with small expenditure of power. The inlet and outlet openings are so placed that the same head or pressure acts upon each tube, insuring an even distribution of the circulating fluid. By arranging the sections in two groups and circulating cold water or brine through the one group and warm water or steam through the other, the heater becomes an effective air dryer, possessing an advantage in that the cooling process does not introduce into the air a mist of water particles. The cleaning of the heater, whether of oil, grease or scale, is simple and easy. After removing one or both of the headers the tubes can be swabbed or scraped out at once and by holding a candle at one end and looking through from the other, their condition is easily seen. The headers stand in a vertical position at the sides of the heater casing and when the covers are removed all the tubes are exposed in convenient position for inspection or cleaning or for removal or repair. The tubes are rolled into the headers like boiler tubes and can be removed or replaced by anyone who has skill enough to replace a tube in a boiler. If it is not desired to put a heater out of service for tube repairs, steam can be shut off from the injured section while the two ends of the defective tube are plugged. The cover plates on the tube headers also are easily replaced. They are held in position by a row of hood bolts, the threaded ends of the bolts projecting through holes in the header cover plate. The making of a joint has been simplified by substituting a rope for the usual gasket. This rope can be laid roughly in place in the groove without fitting, cutting or cleaning, and when the cover is drawn down tightly against it by means of the heavy hook bolts it is tight against the highest steam pressure.

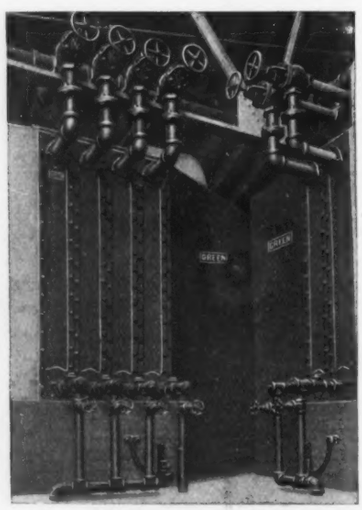
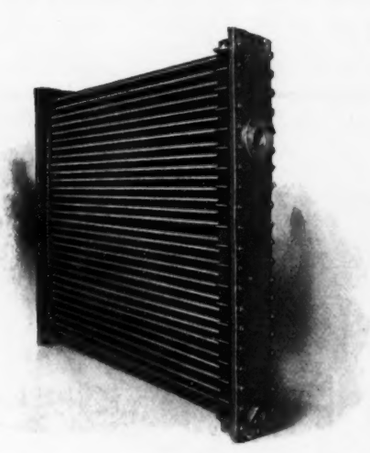


FIG. I.—HOT BLAST HEATER.

The advantages described above relate to the individual heater sections. When using the sections of the heater assembled in hot-blast heating and drying outfits, or for similar purposes, other advantages appear. The individual sections are light, compact and easily handled. Their size and shape permit of their being introduced through narrow doors and stairways. The cost of an air-tight wall on two sides of the heater is

saved, since the header covers fit close to one another, making a good joint and leaving only the bottom and top sides of the header stack to be covered or enclosed. If it is desired to protect the headers with a non-conducting covering this can easily be applied in large removable sheets, since, except for the bolts and nuts, the covers present a smooth and even surface. The sections can be so connected up that some will be



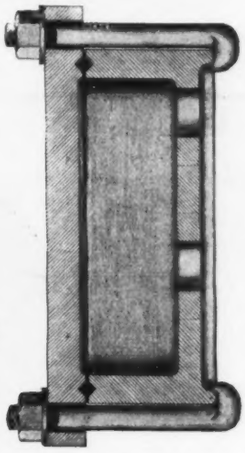


FIG. 2.—INDIVIDUAL SECTION OF HEATER. FIG. 3.—CROSS-SECTION OF HEATER HEADER.

using live steam, say, while others are using exhaust steam or hot water, the valves being so arranged that individual sections can be thrown from one system to the other at will. The heater is made by the Green Fuel Economizer Company, Matteawan, N. Y.

Clamp-Type Outlet and Ceiling Boxes.

The accompanying illustrations show the general construction and features of the clamp-type outlet and ceiling boxes manufactured by the H. Krantz Manufacturing Company, of Brooklyn, N. Y. Each outlet of the box is provided with a threaded extension, the inner edge of which is formed into an insulat-

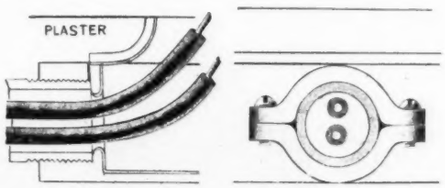
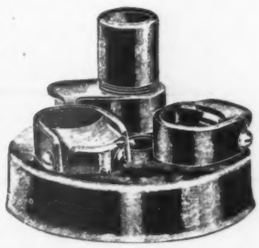


FIG. 1.—CONDUIT CLAMPED TO BOX. FIG. 2.—END VIEW SHOWING CONDUIT CLAMP CLOSED.

ing bushing. The threaded end of the conduit is placed in the threaded extension of the box; the clamp is then placed over the conduit and fastened to the box by means of two screws, as shown. A feature of the box is that no bushings and locknuts are required. Moreover, the labor expense is lessened consid-

FIG. 3.—SIDE CONDUIT CLAMP. FIG. 4.—TOP CONDUIT CLAMP.

erably because of the clamping feature. The top conduit clamp used in connection with the ceiling box is shown in Fig. 4, and the ceiling box itself is shown in Fig. 5. This type of box is especially adapted for such work and is so constructed that all work in connection with the fastening of the conduit is performed from the inside of the box. This makes it possible to use the box without defacing the ceiling in any way. The hole in the ceiling being only the size of the box, the latter is set up to the conduit and the tightening of the set screw under the clamp, as shown, securely locks the conduit to the outlet box. The bracket box is shown in Fig. 6. It is made of sheet steel and stamped in one piece. The lower portion of the clamp is rigidly secured to the box by means of wings which are



FIGS. 5 AND 6.—CLAMP-TYPE CEILING AND BRACKET BOXES.

riveted on the inside. The covers are fastened with four screws to ears on the inside of the box, which is adaptable for both ceiling or wall outlets, and is made with various combinations of outlets. The boxes may be obtained with porcelain lining, which forms an insulating coating that is moisture proof and is not affected by chemicals. The enamel is smooth and hard and adheres to the iron well, a sharp blow being required to chip it. The enamel cannot be cracked by screwing the pipe into the fitting unless enough force is used to split the fitting.

Oil Circuit-Breakers for Use in the Motors.

The oil circuit-breakers illustrated herewith, being intended for use with induction motors, have been so built as to withstand abuse from inexperienced operators. The breakers consist merely of a standard knife switch immersed in oil, with the addition of several arcing contacts for the protection of the main contacts. The auxiliary contacts are made removable, so that they can be replaced should they be burned away in the course of time. The circuit-breaker is made for either switchboard or wall mounting. Fig. 1 shows a circuit-breaker of the latter type, with a single overload coil, and low voltage release. The purpose of the latter is to disconnect the motor from the line should the current supply be interrupted for some

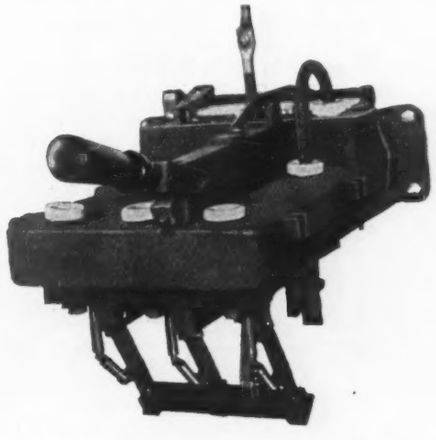


FIG. 1.—CIRCUIT-BREAKER WITH OIL TANK REMOVED.

reason. The operating links are so constructed that it is impossible to close the circuit-breaker while either low-voltage or overload conditions exist. In some cases a panel is provided for mounting an ammeter above the switch, as shown in Fig. 2. The circuit-breakers are made in either two-pole, three-pole or four-pole combinations for currents up to 200 amp, for 600

volts or less, and for currents up to 100 amp for 2500 volts. For the higher voltages barriers of hard fiber are mounted be-

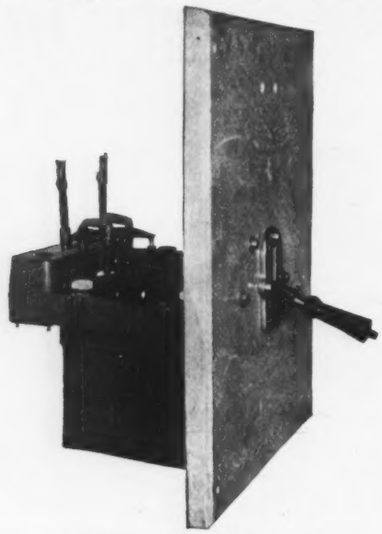


FIG. 2.—OIL CIRCUIT-BREAKER.

tween the switch blades to prevent arcing across. These breakers are built by the Hartman Circuit Breaker Company, Mansfield, Ohio.

Electric Heating Iron.

The accompanying illustrations show the features of the electric heating iron made by the Pelouze Electric Heater Company of Chicago, Ill. The electricity is controlled at the iron by a simple motion of the hand and when not in use the iron is tipped back until it rests on the end of the handle and the switch is pushed down to cut the iron out of circuit. The heat-

FIG. 1.—POLISHING IRON. FIG. 2.—IRON AS DISK HEATER.

ing element is complete in itself, including all contacts, and is easily replaceable. When furnished with a support the iron can be converted into a stove or heating disk. The heating element is composed of a coil wound in a flat plane and it operates directly on the bottom of the iron. The heat is so distributed that while the body of the iron is uniformly heated, the point

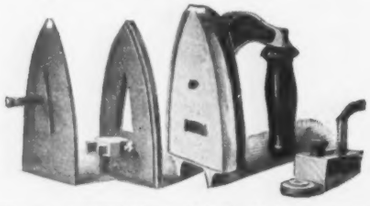


FIG. 3.—COMPONENT PARTS OF IRON. FIG. 4.—METHOD OF CONTROL OF TEMPERATURE.

and the edges receive extra heat, so that delicate work can be performed without danger of scorching from an overheated center. The iron, which is balanced and has a handle supported only at one end, requires 3.8 amp at 110 volts. It is built in three sizes, has a bottom temperature of 500 deg. Fahr. and is said to be quick starting; that is, ready for work in three minutes.

Separately-Excited, Revolving-Field, Belt-Driven Alternators.

In the generators illustrated herewith the field structure consists of laminated pole-pieces dovetailed into a laminated iron spider, the punchings being stacked and riveted together. Two methods of building the field coils are used. For the 50-kw and 75-kw sizes the wire is wound on spools which are slipped over the pole-pieces and held in place by the enlarged pole tips. In the larger sizes the field coils consist of a single strip of flat copper wound on edge so that one surface of every turn is exposed to the air. This construction permits effective insulation

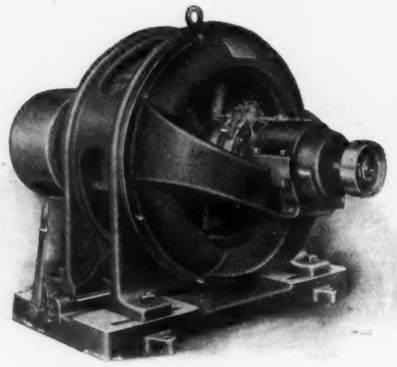


FIG. 1.—BELT-DRIVE ALTERNATOR.

between each turn of the field winding and insures a low temperature in operation.

The collector rings for the field circuit are mounted on insulating bushings located on the shaft and are exposed to the air on all sides. Two or more carbon brushes are provided for each ring.

These generators have been especially designed for use in isolated plants where mixed lighting and motor loads are the rule rather than the exception. It is practically impossible in such cases to obtain good voltage regulation by hand control, and some form of automatic voltage regulator must be used. For this service the makers recommend the Tirrill regulator for automatically varying the field current, so as to maintain prac-

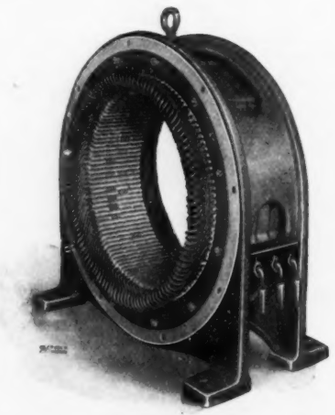


FIG. 2.—ARMATURE OF ALTERNATOR.

tically constant voltage at the busbars, or at the center of distribution, as may be desired. When intended for operation as synchronous motors, the machines are equipped with a squirrel-cage winding located in the revolving-field pole-pieces, so that they may be started from rest as induction motors. These machines are built with either two-phase or three-phase windings and for 240, 480, 600, 1150 and 2300 volts by the General Electric Company, Schenectady, N. Y.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

Holiday quiet has been predominant in trade during the past week. It is always the case that business is practically stagnant between Christmas and New Year's. The big buying which usually occurs in retail lines just before the holidays practically exhausts the resources of purchasers. In jobbing and wholesale houses there is litttle being done except inventory taking. It is the habit of all such establishments to spend the last week of the year taking stock of what has been done and preparing to start afresh with the beginning of the new year. Dullness at this time is, therefore, not surprising and is, in fact, anticipated. Taken altogether there is a distinct note of optimism as to the future. While the more intelligent observers do not expect any great boom in business during 1909, they do anticipate a steady increase in all lines of legitimate trade until the normal basis of 1906 and of the early portion of 1907 is attained. This may be retarded for some months by the agitation of the tariff. It is not believed that it will be seriously interfered with by any action that Congress may take in regard to lowering duties. Business men are confident that while tariff rates will be materially reduced there is little likelihood of their being cut at any particular point to a sufficient degree to interfere with legitimate business. The only serious trouble that is feared is a prolonged discussion of the matter. What merchants want and what manufacturers want is a speedy settlement. It is the uncertainty that retards business, that causes all branches of industry and trade to feel like waiting until the basis is fixed. It is pretty well known that wholesalers and retailers alike are lightly stocked. This, of course, means that heavy purchases will be necessary when the consuming public begins to demand goods. The only real active market during the past week was that of raw wool. In Boston there were large sales made of Western fleeces—estimated to be about 10,000,000 lb.—and the price is higher and firmer. This, of course, indicates that the manufacturers of woolen goods are preparing for active work during the coming season. There were few orders for iron and steel products recorded during the week, and in the rail market it appears that all prospective purchasers have been holding off in order that their contracts may be made in 1909. Business failures for the week ended Dec. 30 numbered 299 against 222 the previous week, 345 in the week which ended Jan. 2, 1908, 185 in the similar week in 1907, 220 in 1906 and 278 in 1905.

THE COPPER MARKET.

During the last few days of the old year there was a trifle more activity displayed in copper, although the sales for domestic consumption were small. There was some renewed activity in Europe, which, of course, stimulated the local market to some extent. There were in this market considerable amounts taken by the foreigners for January shipment, and there were also some sales made for February and March exportation. The takings of domestic consumers were confined to small lots, although the wire drawers and electrical manufacturers were in the market to some extent. In the last two days of 1908 probably 3,000,000 lb. were sold in this market, but a good portion of this was arbitrage business where purchases were made here to cover speculative sales made in Europe. The appearance of the report of L. C. Graton, of the United States Geological Survey, for 1907, an abstract of which will be given next week, made its appearance, but caused little interest. The figures are only valuable for showing how right and how wrong the previous estimates have been and for the frank admission that no figures are very accurate under the present loose methods of collecting returns. One of the most important figures contained in the report is that at the beginning of the year there was a stock on hand of 125,745,796 lb. This figure is particularly interesting in connection with the advance estimate of 1908 statistics which the government gave out Dec. 31. These calculate, in round numbers, that the production in the United States in 1908 was approximately 900,000,000 lb., or about 30,000,000 lb. more than in 1907. The imports for the year have been at least 210,000,000 lb., which, taken together with the carry-over on Jan. 1, 1908, make a total stock of copper of 1,235,000,000 lb. which came in sight during the year. The exports for the year are about 650,000,000 lb., and according to the best estimates of local statisticians, the domestic consumption has been 372,000,000 lb. Deducting this estimated disposition of copper from the known supply, we have left in stock on the first of January, 1909, in this country 213,000,000 lb. As has been previously stated, the accumulations in Europe amount to something like 225,000,000 lb., so that there is apparently a surplus of 438,000,000 lb. for the consumers of the world to draw on. These figures will, of course, be denied by the producers and selling agencies, and there is no guarantee that they are accurate. It must be remembered, however, that they are the best that can be collected; that they are gathered by an entirely disinterested agency and that their government backing gives them a semi-official character. Speaking of the future, the latest government bulletin says: "The prospect is bright at present for a still larger copper production in the year 1909, but it is evident that the principal producers will, more than in recent years, gage their operations by the consumption of the metal, which cannot at this time be safely forecasted." Whether the producers will gage their output by the demand is a question. They have not done so in 1908, and as there seems to have been no trouble about keeping prices steady during this year of industrial depression, why should there be any anxiety over 1909, when the consumption of copper may be expected to increase? During the week under review the price of copper has actually been advanced, and there have been no reports of price shading and large contracts for future delivery at current figures have been declined. Quotations on the Metal Exchange Jan. 4 were:

Lake	14⅜ @ 14⅝
Electrolytic	14⅛ @ 14⅜
Castings	14 @ 14¼

Following are the London quotations:

	Noon. £ s d	Close. £ s d
Standard copper, spot	64 2 6	63 17 6
Standard copper, futures	64 17 6	64 12 6
Market	Firm.	Easy.
Sales of spot		500 tons
Sales of futures		1,000 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Lake copper, spot	14½	12⅜
Electrolytic copper, spot	14⅜	12¼
Casting copper, spot	14¼	12⅛
London, spot	£64 17 6	£56 5 0
London, futures	65 15 0	56 17 0
London, best selected	68 10 0	50 0 0

ENGINEERING IN BRAZIL.—It is announced by the *Brazilian Review* that the government of the State of Espirito Santo has signed a contract with Dr. Augusto Ramos for the installation of water supply, electric lighting and a drainage system at Victoria, the capital of the State. Work must be commenced within 30 days and completed within 14 months. The water supply will amount to about 25,000,000 gal. every 48 hours, and the electrical energy will amount to about 800 hp. This concession is considered valuable owing to the extensive mineral resources of the interior of the country.

PLANT FOR INDIA.—U. S. Consul-General William H. Michael, of Calcutta, reports to the Department of Commerce and Labor that a British company, having failed to put in an electric lighting plant in Lucknow, India, according to the terms of a franchise granted to it about three years ago, the municipality of that city proposes to cancel the franchise and make other arrangements. The municipality passed a resolution inviting tenders by advertisement for lighting the city by gas or electricity.

LIGHTING IN SOUTH AMERICA.—A Consul in South America reports to the Department of Commerce and Labor that a concession has been granted by the government in the country in which he is located to a local firm for the establishment of an electric lighting plant in a municipality of about 9,000 inhabitants. Manufacturers of electric lighting apparatus may secure sales by addressing the firm whose address is given by the Consul.

BRITISH THOMSON-HOUSTON CONTRACTS.—The British Thomson-Houston Company, Ltd., of Rugby, England, reports as follows some of the more important motor home contracts secured by its power and mining department: Carling How Mines (Durham), five three-phase motors, 6½ to 175 hp, aggregating 321½ hp, together with controllers, switchgear, mechanical gearing, emergency brake and three-throw ram pump; Sheffield Coal Company, one 250-kw a.c. generator, seven three-phase motors, 30/80 hp, total 320 hp, controllers, resistances, transformers and switchgear; Joshua Whiteley & Company, Ltd., Albion Mills, Huddersfield, 23 three-phase motors, 6/55 hp, totaling 928 hp, together with switchboards, control panels, necessary wiring, etc.; J. & P. Coats, Ltd., Glasgow, eight three-phase motors, 300/325 hp, total 2600 hp, with controlling gear, panels, etc.; Pease & Partners, Darlington, one 125-kva generator, one 45-hp and one 70-hp motors (total 115 hp), with switchboard controllers and resistances, also two 15/25-hp motors, total 40 hp, control panels, etc., also two 25/120 hp, 145-hp motors, one 130-hp transformer, controllers, resistances and switchgear; Fife Coal Company, Leven, 19 three-phase motors, 25/50 hp, 660 hp, with controlling gear; Aveling & Porter, Ltd., Rochester, eight three-phase motors, 2¼/16 hp, 105¾ hp, with rheostats, wiring, etc.; London Corporation (for Central Criminal Court), eight 8-hp, 64-hp d.c. motors, with starters and panels; Gwynnes, Ltd., testing plant for Borough of Hammersmith, one 120-kw motor-generator set, one 110-kva generator; one 146-hp motor; one 10-kw exciter, one 140-kw transformer with switchgear; Greeves, J. & T. M., Ltd., Belfast, eight three-phase motors, 2/60 hp, 92 hp, with switchgear; Glenboig Union Fire Clay Company, Ltd., Glenboig, N. B., 20 three-phase motors, 1225 hp, with controllers, resistances, panels, etc.

WESTINGHOUSE MACHINE COMPANY.—The business of the Westinghouse Machine Company is showing some improvement, and several good sized orders have been received at the East Pittsburgh shops within the last few days. Among these orders was one for a large steam engine from the Pennsylvania-Arizona Mining Company, of Poland, Ariz., which will be used to operate the power machinery of a copper mine. The city of Frankfort, Ind., has ordered a 750-hp steam turbine; the American Iron & Steel Company, which is erecting a new plant at Lebanon, Pa., a 1500-hp steam turbine outfit; the American Plate Glass Company, a 1000-hp gas engine, an electric generator, and a switchboard for a complete power plant for its new factory at James City, Pa.; the Standard Underground Cable Company, Pittsburgh, for its plant at Perth Amboy, N. J., a 1000-hp horizontal double-acting gas engine; the Rockland Light & Power Company, of Nyack, N. J., a 1000-hp turbine equipment; the Youngstown Sheet & Tube Company, a 3000-hp turbine set, and the Warren Street Railway Company, of Warren, Pa., a 500-hp gas engine. An interesting feature of the new orders which have been coming to the East Pittsburgh plant of the Westinghouse Electric & Manufacturing Company recently is the very large demand for motors and power-house machinery from mills, mines and other large industrial establishments. Among the companies for which these shops are turning out motors for machine-driving purposes are the Anaconda Copper Mining Company; the Dixie Portland Cement Company, of Iola, Kan.; the Southern Power Company, of Charleston, S. C.; the American Trading Company; the American Iron & Steel Company; the Mead-Morrison Manufacturing Company, of Cambridge, Mass.; the Connellsville Iron Works, of New Haven, Pa.; the Mesta Machine Company, of Homestead, Pa.; the Fairmont Coal Company, of Fairmont, W. Va.; Hoover & Mason, mill engineers, Chicago, Ill.; Boyts-Potter Company, Connellsville, Pa.; the Manufacturers' Outlet Company; the United States Electrical Tool Company, of Cincinnati, O.; the Whiting Foundry & Equipment Company, of Harvey, Ill.; the Tompkins Engineering & Construction Company, of New York City, and the Youngstown Sheet & Tube Company, of Youngstown, O.

TO MANUFACTURE NEW GAS ENGINE.—The New York Air Brake Company, through a subsidiary company—the New York Machine Company—is preparing to manufacture gas and fuel engines on a large scale. The company is not ready as yet to give out its plans for developing this engine, but the apparatus is being manufactured at the plant in Watertown, N. Y., and will be offered for inspection in about 30 days. The new company, of which William N. Shaw, treasurer of the Air Brake Company, is president, believes that the new engine which it will offer will be a great fuel saver and that it will work a practical revolution in the gas-engine industry. The original design of the engine, it is understood, was made in Russia, and the American rights are owned by the American Machine Company. The highest capacity of engine that will be attempted at the present time will be 500 hp, but there is no reason why higher powers should not be made in the future. It is claimed, among other things, that the new engine will produce 1 hp per hour for every pound of coal consumed.

Financial Intelligence.

THE WEEK IN WALL STREET.

After a week of dull trading and advancing prices the stock market suddenly exploded with a loud noise on Jan. 4, when the decision of the Supreme Court, adverse to the Consolidated Gas Company, was made public. This decision, which practically upholds the 80-cent gas law, came after two lower courts had ruled that it was unconstitutional. It means that the gas company will receive 20 per cent less in its gross receipts and will have to return to the consumers the $9,000,000 collected in excess of the 80-cent rate since May, 1906. The stock of the gas company broke from 165¼ at the opening to 138, and closed at 141, a net loss from the close on Saturday of 23 1-4 points. The transactions amounted to 51,725 shares. So great was the rush to sell that the tape was sometimes almost an hour behind the actual trading. The effect on the general market was to break many of the higher-priced stocks, and almost every issue on the list closed the day at a decline. So great was the interest in the gas decision that the Street for the moment overlooked the fact that the Supreme Court had finally decided that the Government could not re-open the case involving the tremendous fine imposed upon the Standard Oil

NEW YORK.

	Dec. 28.	Jan. 4.	Shares Sold.		Dec. 28.	Jan. 4.	Shares Sold.
All.Ch.	16	15⅛	1,700	Int.-Met., pfd...	47⅞	46¾	35,920
All.-Ch., pfd....	50	49½	2,000	Mackay Cos....	75*	76	700
Amal. Cop.	84½	82⅞	92,450	Mackay Cos.,pfd.	70	70	300
Am. D. T.....	35*	35*	——	Manhattan Elev.	154½	152	1,590
Am. Loc.	58¼	56½	14,550	Met. St. Ry....	42½	40	1,400
Am. Loc., pfd..	111	114*	450	N.Y. & N.J.Tel.	112*	112*	——
Am. Tel. & Cbl.	78*	78*	——	Steel, com.....	54¼	52⅞	233,791
Am. T. & T....	129	127¼	6,920	Steel, pfd.....	112¾	112⅞	12,945
B. R. T.....	68	69½	108,365	W. U. T.....	68⅜	68½	5,200
Gen. Elec.....	160½	156	8,300	West'h., com...	85½	85	4,520
Int.-Met., com..	19	17¾	43,225	West'h., pfd....	120*	120	——

PHILADELPHIA.

	Dec. 28.	Jan. 4.	Shares Sold.		Dec. 28.	Jan. 4.	Shares Sold.
Am. Rys.	45¾*	45	——	Phila. Elec. ...	11¾	11¾	——
Elec. Co. of A..	11	11⅛*	——	Phila. R. T....	23⅛	25½	——
Elec. Stor. B'ty.	46½	47	——	Phila. Traction..	90½	90½*	——
E. S. B'ty, pfd..	49*	49*	——	Union Traction..	50⅜	51½	——

CHICAGO.

	Dec. 28.	Jan. 4.	Shares Sold.		Dec. 28.	Jan. 4.	Shares Sold.
Chi. City Ry....	180*	180*	——	Chi. Tel. Co....	127½	127	——
Chi. Rys., Ser.1.	116	116*	——	Met. El., com...	18*	17	——
Chi. Rys., Ser.2.	45⅛	45½*	——	Nat'nal Carbon.	85	85*	——
Com. Edison...	107	108	——	Nat. Carb., pfd.	112*	112	——
Chi. Subway...	30⅜	28¾	——				

BOSTON.

	Dec. 28.	Jan. 4.	Shares Sold.		Dec. 28.	Jan. 4.	Shares Sold.
Am. Tel. & Tel.	129½	127½	——	Mass. E. R.,pfd.	58	60	——
Cum. Tel.	125⅜	126	——	Mex. Tel.	2½	2½*	——
Edison El. Ill...	241	247	——	Mex. Tel., pfd.	5½*	5½*	——
Gen. Elec.	160½	157	——	N. E. Tel.....	126¾	126¾*	——
Mass. Elec. Ry.	12⅛	12	——	W. Tel. & Tel..	7⅜*	8	——
				W. T. & T., pfd.	78½*	81	——

*Last price quoted.
Shares sold are for week Dec. 28 to Jan. 2.

Company. At a less excited period such a decision as this would have been received as a distinct victory for corporate interests, and would have done much to strengthen the market and inspire confidence. An alliance of the principal financial interests of the country was made early in the spring to sustain the stock market. The quotations at the end of the year show how remarkably successful the efforts of these interests have been. Whether this alliance will continue to uphold the market or whether we may expect a general effort to secure profits is now the problem. No one knows what the program will be, but there has been a persistent rumor that January had been fixed as the date when the partnership bull movement would be dissolved. The public is not yet buying stocks liberally, and this may prevent any loosening of the grip upon the market which the insiders now have. In the meantime there is a vast investment demand for bonds and all issues offering good security are rapidly gobbled up. It is now said that the advance subscriptions to the $30,000,000 Frisco issue have been

so heavy that the subscription books will be closed as soon as they are opened. There is some interest felt in the report that the Pennsylvania Railroad will increase its indebtedness by $60,000,000. As the money which the Pennsylvania raises by bond issues is always put into tangible improvements, its issues are always popular. Money continues to be cheap, although rates are not so low as they were a couple of months ago. On January 4 call loans were made at 2 and 3 per cent, and 90-day paper was quoted at 3 and 3 1-4 per cent. The quotations in the table are those at the close Jan. 4.

DIVIDENDS.

Aurora, Elgin & Chicago Railway, Chicago, Ill., quarterly, common, 1 per cent, payable Jan. 11.

Aurora, Elgin & Chicago Railway, Chicago, Ill., quarterly, preferred, 1 1-4 per cent, payable Jan. 11.

E. W. Bliss Company, Brooklyn, N. Y., quarterly, preferred, 2 per cent, payable Jan. 2.

E. W. Bliss Company, Brooklyn, N. Y., quarterly, common, 2 1-2 per cent, payable Jan. 2.

Evansville (Ind.) Light Company, quarterly, preferred, 1 1-2 per cent, payable Jan. 2.

Gamewell Fire Alarm Company, New York, N. Y., quarterly, 1 1-4 per cent, payable Jan. 2.

Halifax (N. S.) Electric Tramways, Ltd., quarterly, 1 1-2 per cent, payable Jan. 2.

Indianapolis Traction & Terminal Company, Indianapolis, Ind., initial dividend of 1 per cent, payable Dec. 31.

Knoxville Railway & Light Company, Knoxville, Tenn., quarterly, common, 1 per cent, payable Dec. 31, 1908.

Knoxville Railway & Light Company, Knoxville, Tenn., preferred, quarterly, 1 1-2 per cent, payable Dec. 31, 1908.

Lancaster County Railway & Light Company, Lancaster, Pa., quarterly, common, 2 per cent, payable Jan. 1.

Lancaster County Railway & Light Company, Lancaster, Pa., quarterly, preferred, 1 1-4 per cent, payable Jan. 1.

National Light, Heat & Power Company, New York, N. Y., quarterly, preferred, 1 1-4 per cent, payable Jan. 2.

Standard Underground Cable Company, Pittsburgh, Pa., quarterly, 3 per cent, annual extra 3 per cent, and special extra of 7 per cent.

Washington Water Power Company, Spokane, Wash., common, quarterly, 1 3-4 per cent, payable Jan. 20.

COMMONWEALTH EDISON COMPANY.—The Commonwealth Edison Company, Chicago, has sold $10,000,000 of 5 per cent first mortgage bonds to a syndicate composed of the Illinois Trust & Savings Bank, Merchants' Loan & Trust Company, Northern Trust Company, First Trust & Savings Bank, Harris Trust & Savings Bank, N. W. Halsey & Company, and Russell, Brewster & Company, of Chicago. About $7,000,000 of these bonds will be used for immediate refunding purposes, leaving about $3,000,000 for extensions and improvements. The securities to be retired include $5,000,000 of 5 per cent three-year gold debenture bonds of the Chicago Edison Company due on Nov. 1, 1910; $1,483,000 of 6 per cent debentures of the Chicago Edison Company due on Jan. 1, 1913; $500,000 of 5 per cent debentures of the Commonwealth Electric Company due on Aug. 1, 1909, and $260,000 of 4 per cent first mortgage bonds of the Chicago Sectional Electric Underground Company.

EDISON ELECTRIC COMPANY OF LOS ANGELES.—Announcement was made in the ELECTRICAL WORLD of Jan. 2, 1909, page 77, of a meeting of the stockholders of the Edison Electric Company of Los Angeles, called for Feb. 27, 1909, to vote on a plan to issue $30,000,000 of bonds. In connection with the proposed issue, Mr. John B. Miller, president of the company, is quoted as saying: "This is a measure designed to enable the company to keep pace with the increased demand for gas and electricity in all of its districts. The company has prepared a program involving the expenditure of several million dollars in Southern California during 1909 and 1910, but the money for these expenditures will be provided from the sale of bonds, the stock remaining in the treasury. These bonds will be marketed in the East, as money is needed for extensions in and about Los Angeles."

BOSTON ELEVATED RAILWAY.—The annual meeting of the stockholders of the Boston Elevated Railway was held in Boston on Jan. 4, 1909. The directors of the company were all re-elected. At the meeting, the annual report of the company for the year ended Sept. 30, 1908, was presented. It shows gross earnings, $14,074,696; operating expenses, $9,454,385; net earnings, $4,620,310; fixed charges, $3,780,246; surplus, $840,063 and balance after dividends $42,063. The general balance sheet of the company, dated Sept. 30, 1908, shows assets of $35,428,644, and liabilities of $35,428,644. A summary of stockholders of record on Oct. 1, shows a total of 3657, of whom 3214 reside in Massachusetts and hold 115,512 shares of the total of 133,000 shares of stock outstanding.

BLACKSTONE VALLEY GAS & ELECTRIC COMPANY.—Stone & Webster, Boston, Mass., recommend for investment $1,750,000 of collateral trust 5 per cent gold bonds of the Blackstone Valley Gas & Electric Company, Pawtucket, R. I., due Jan. 1, 1939. The bonds are offered at 97½ and interest, yielding more than 5⅛ per cent. They cover the gas and electric lighting properties in the cities of Pawtucket and Woonsocket and in the adjacent towns located in the Blackstone Valley, Rhode Island. The net earnings of the company for each of the last three years show more than twice the interest requirements for the $1,750,000 of bonds.

LAKE SUPERIOR CORPORATION.—Horatio G. Lloyd has announced that Robert Fleming, London and New York, was the purchaser of the securities of the Lake Superior Corporation, Sault Ste. Marie, Mich., from Philadelphia institutions. It is understood that Mr. Fleming represents English and Canadian capitalists who with Edward J. Berwind and his associates now control the Lake Superior Corporation. The Lake Superior Corporation wil be refinanced and members will be elected to the directorate of the company to represent the new interests.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY.—The Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., paid interest due on outstanding bonds Jan. 1 and set aside $500,000 for the sinking fund and $220,000 to pay obligations, preliminary to the opening of the new balance sheet. The company began 1909 with about $12,000,000 in cash, $5.000,000 in current accounts receivable, $1,500,000 in current bankable funds, and it has other assets that can be converted into cash as market conditions permit.

CONSOLIDATED RAILWAY, LIGHTING & REFRIGERATING COMPANY.—Mr. Isaac L. Rice, chairman of the reorganization committee of the Consolidated Railway, Lighting & Refrigerating Company, of New York, has announced that more than 142,000 shares of a total of 211,158 have consented to the reorganization plan and that no further deposits of stock will be accepted under the terms of the plan, which provided for an assessment of 25 cents a share.

WASHINGTON WATER POWER COMPANY.—Lee, Higginson & Company, Boston, are offering for subscription $3,000,000 of 30-year bonds of the Washington Water Power Company, Spokane, Wash. The proceeds of the issue are to be used to refund $3,000,000 of notes due on July 1, 1911. In the exchange note-holders are offered a bonus of $15 cash on each $1,000 of notes. The limit of exchange is Jan. 31, 1909.

ILLINOIS TUNNEL COMPANY.—The Illinois Tunnel Company, Chicago, Ill., has agreed to report annually to the city comptroller of Chicago and to give full publicity of all its accounts, in consideration of a two-year extension of time within which its automatic telephone department must install 20,000 telephones. The plant will be maintained at its present standard and the company will give a new $100,000 bond.

FRONTIER TELEPHONE COMPANY.—The stockholders of the Frontier Telephone Company, Buffalo, and the Inter-Oceanic Telephone & Telegraph Company have voted to sell their properties to the Federal Telephone & Telegraph Company, which was incorporated recently with a capital stock of $6,000,000. Among the directors of the Federal Telephone & Telegraph Company are B. G. Hubbell and H. H. Person, Buffalo.

NEW YORK TRANSPORTATION COMPANY.—The directors of the New York (N. Y.) Transportation Company are reported to have under consideration the advisability of placing a first mortgage on the property of the company to secure between $2,000,000 and $3,000,000 for equipping the company's cabs for the use of gasoline instead of electricity as motive power.

H. M. BYLLESBY & COMPANY, Chicago, Ill., owners and operators of a number of electric light and power, gas and electric railway properties in the Middle West and the South, reports that the year 1908 has been one of progress with it and its subsidiary companies. During the year the company has handled more bond securities than ever before in any one year. The company's bond security department, which was installed about a year ago, has assumed such a permanent

character that it has been found necessary to appoint a manager who will devote his exclusive attention to this department. Mr. R. A. Wilson, a well-known bond security expert of New York City, has been placed in charge of this department. During the year just closed a very commendable increase in the year's gross business has been reported by the following companies, the properties of which are controlled by H. M. Byllesby & Company: Oklahoma Gas & Electric Company, Oklahoma City, Okla.; Enid Electric & Gas Company, Enid, Okla.; Mobile Electric Company, Mobile, Ala.; Ottumwa Railway & Light Company, Ottumwa, Ia.; Fort Smith Light & Traction Company, Fort Smith, Ark.; San Diego Consolidated Gas & Electric Company, San Diego, Cal. The increase of business shown by these properties was brought about through the gradual growth of the cities, through property betterments, systematic soliciting business methods, and the introduction of electric utensils for household uses. Because of this increase of business at each of these plants, it has been necessary during the year to make many improvements in the electric generating stations. In addition to these power plant improvements, many extensions of the feeder lines were made throughout the cities in which the companies operate. The parent company reports that improvements to the generating stations are now being made to the properties of the companies named as follows: At San Diego, Cal., the company is installing a new 1,000,000-cu. ft. gas generating set and a 1500-kw generator, direct connected to a cross-compound Corliss engine. The improvements in this city will exceed $200,000. At Enid, Okla., the company is adding to its local plant a 400,000-cu. ft. oil gas-producing set. The improvements at the electric light plant in that city will include three B. & W. 300-hp boilers and a 500-kw generating set. H. M. Byllesby & Company expects that 1909 will be the most active year in its existence. Besides the general improvements that will be made to its several properties it will develop three very large water power projects in the West, preliminary work on which has already been begun. The company has recently finished the construction of a water power plant of interesting design at Sioux Falls, S. D.

BOSTON & WORCESTER ELECTRIC COMPANIES.—The Boston & Worcester Electric Companies and the Boston & Worcester Street Railway have issued statements of their earnings for the year ended Sept. 30, 1908. The Boston & Worcester Electric Companies owns the capital stock of the Boston & Worcester Street Railway. It reports a total income from its stock holdings and other sources of $141,661. From this sum was deducted dividends, interest on $235,000 of three-year notes and miscellaneous expenses amounting to $141,047, leaving a surplus of $613. The statements of earnings of the Boston & Worcester Street Railway shows gross receipts of $553,613 and operating expenses of $282,917, leaving the net income $270,696. The charges for the year are given as $155,965, leaving a surplus of $114,731. As dividends amounting to $121,500 were paid there was a deficit for the year of $6,768.

NEW JERSEY & PENNSYLVANIA TRACTION COMPANY, TRENTON, N. J.—J. R. Nutt, secretary of the Citizens' Savings & Trust Company, Cleveland; Myron H. Wilson, vice-president of the Cleveland Trust Company, Cleveland, and James G. Cannon, president of the Fourth National Bank, New York, have been selected as a committee to represent the bondholders of the New Jersey & Pennsylvania Traction Company and the Trenton, New Hope & Lambertville Traction Company, in which Mayor Tom L. Johnson, of Cleveland, and the estate of Albert Johnson are interested.

HUDSON RIVER WATER POWER COMPANY.—The committee of bondholders of the Hudson River Water Power Company, Saratoga Springs, N. Y., of which Mr. F. J. Lisman is chairman, has announced that proceedings to foreclose the mortgage will be instituted promptly, as a sufficient number of bonds have already been deposited. The holders of the receipts from another committee, of which Mr. James R. Hopper is chairman, will be given the option of depositing their receipts with the committee of which Mr. Lisman is chairman in lieu of bonds.

HUDSON RIVER ELECTRIC POWER COMPANY.—The Public Service Commission of the Second District of New York has granted permission to the receivers of the Hudson River Electric Power Company, Glens Falls, N. Y., to lease the steam power plant and property of the company at Utica and the substations at Little Falls, Frankfort and Oriskany to the Utica & Mohawk Valley Railway.

REPORTS OF EARNINGS.

	Gross Earnings.	Expenses.	Net Earnings.	Charges.	Surplus.
Aurora, Elgin & Chicago Railroad, Chicago, Ill.:					
November, 1908	$109,912	$64,969	$44,942	$27,723	$17,219
November, 1907	108,653	63,192	45,461	28,033	17,427
Cleveland, Painesville & Eastern Railroad, Cleveland, Ohio:					
November, 1908	21,858	13,550	8,308	.....	.....
November, 1907	22,474	12,984	9,490	.....	.....
Edison Electric Illuminating Company, Brockton, Mass.:					
October, 1908	19,218	10,020	9,197	2,861	6,336
October, 1907	19,393	9,896	9,496	1,051	8,445
Houghton County Electric Light Company, Houghton, Mass.:					
October, 1908	23,273	11,171	12,101	4,080	8,021
October, 1907	24,306	11,634	12,672	2,962	9,709
Illinois Traction System, Champaign, Ill.:					
November, 1908	360,679	196,382	164,296	.....	.....
November, 1907	335,889	195,595	140,293	.....	.....
Lake Shore Electric Railway, Cleveland, Ohio:					
November, 1908	68,352	40,716	27,636	.....	.....
November, 1907	69,836	46,667	23,168	.....	.....
Lowell (Mass.) Electric Light Corporation:					
October, 1908	30,673	17,824	12,848	2,849	9,999
October, 1907	29,056	15,686	13,370	3,323	10,046
Minneapolis (Minn.) General Electric Company:					
October, 1908	86,679	34,790	51,889	32,596	19,293
October, 1907	76,921	37,184	39,737	26,646	13,090
Nashville (Tenn.) Railway & Light Company:					
November, 1908	138,598	79,271	59,327	32,507	26,820
November, 1907	139,559	87,182	52,377	31,232	21,145
Paducah (Ky.) Traction & Light Company:					
October, 1908	16,706	10,268	6,437	6,590	152*
October, 1907	19,075	12,374	6,700	6,883	182*
Pensacola (Fla.) Electric Company:					
October, 1908	18,345	10,432	7,913	4,261	3,652
October, 1907	20,045	14,296	5,749	4,360	1,389
Toledo (Ohio) Railways & Light Company:					
November, 1908	219,885	117,372	102,513	71,960	30,553
November, 1907	220,754	116,957	103,797	67,925	35,872

* Deficit.

GENERAL NEWS

Construction News.

GLOBE, ARIZ.—George W. P. Hunt has applied to the City Council for a franchise to construct and operate an electric street railway through Globe.

BENTONVILLE, ARK.—It is said that the construction of an interurban electric railway from Bentonville, Ark., to Joplin, Mo., is assured. The railway will be 168 miles in length.

HOLLY GROVE, ARK.—Arrangements are being made by E. W. Burruss to install an electric light plant in Holly Grove, the cost of which is estimated at $3,000.

LITTLE ROCK, ARK.—It is reported that Eastern capitalists have agreed to furnish the greater portion of the funds needed for the construction of an interurban railway connecting Hot Springs and Little Rock by the Little Rock & Hot Springs Electric Railway Company. The railway will be 51 miles in length and will cost about $1,500,000. Bids for the construction of the road will be asked for in the near future.

BERKELEY, CAL.—The City Council has granted the Southern Pacific Company a franchise to operate an electric railway over California, Ninth and Ellsworth Streets in Berkeley, for which the company bid $25,000. Duncan McDuffie was granted a franchise by the Council for an extension of the present Grove Street railway in Northbrae on Marin and Alameda Avenues, for which he paid $250.

NORWALK, CAL.—J. R. Gordan is reported to have been granted a franchise by the town to install an electric light and power system.

PASADENA, CAL.—It is stated that the City Council is contemplating calling an election the latter part of January or early in February to vote on the proposition to issue bonds to complete the municipal electric light plant. The plant can be completed, it is said, for less than $150,000.

RIVERSIDE, CAL.—Bonds to the amount of $50,000 have been issued by the Corona Home Telephone & Telegraph Company, the proceeds to be used for improvements to its system.

WARD, COL.—Arrangements are being made by the Mount Audubon Power Company for the construction of a hydro-electric plant, which will be located about 1½ miles northeast of Ward. The water will be conducted from the St. Vrain River to reservoirs near Duck Lake, from which it will be carried in a 20-in. pipe with a fall of 500 ft. in a distance of one mile. Actual construction work will commence on the plant in the spring, and when completed will furnish electricity to mines of the district. The plant will cost about $75,000 and will have an output of 1500 hp. J. E. Haggard is president and general manager.

MANCHESTER, CONN.—The Glastonbury Light & Power Company will make improvements to the street lighting system in the North End. Orders have been placed for four transformers, which will be placed in the power station of the Connecticut Company.

NEW LONDON, CONN.—Announcement has been made by the New London & East Lyme Street Railway Company that it will petition the incoming Legislature for charter amendments granting the company permission to extend its railway to the Connecticut River.

NEW LONDON, CONN.—The Groton & Stonington Street Railway Company will petition the next session of the Legislature for amendments to its charter allowing it to extend its system through several streets of Groton Borough and to Eastern Point.

NORWICH, CONN.—The Norwich & Westerly Railway Company has filed a petition with the Secretary of State, asking the State Legislature for an amendment to the resolution incorporating the Norwich, Mystic & Westerly Street Railway Company so that it may be allowed to furnish electricity for lamps and motors in the towns of Preston, Ledyard and North Stonington.

PUTNAM, CONN.—The Putnam Light & Power Company, it is said, will petition the Legislature for an amendment to its charter, granting it permission to extend its transmission lines to Woodstock and erect a distributing system in that town to furnish electricity for lamps and motors.

SOUTH NORWALK, CONN.—The Reed & Volk Electric Company has been awarded a contract to furnish the municipal electric light plant with incandescent lamps. The contract calls for 10,000 lamps.

UNIONVILLE, CONN.—The Union Electric Light & Power Company will apply to the General Assembly for amendments to its charter giving the company permission to generate and distribute gas in the towns of Farmington, Canton, Avon and Burlington.

WILMINGTON, DEL.—Anthony Higgins, representing the Commercial Light, Heat & Power Company, which was granted a franchise in 1907 to erect an electric light plant in Wilmington, has applied to the Directors of the Street and Sewer Department for an extension of time from Jan. 1, 1909, to Jan. 1, 1911, for the fulfilment of its agreement in connection with the franchise.

WASHINGTON, D. C.—The contract for furnishing a switchboard for the new building for the National Museum, Washington, D. C., has been awarded to the Walker Electric Company, for $9,475.

WASHINGTON, D. C.—Bids will be received until Feb. 9 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing ammunition hoists and electrical equipments at the navy yard, Puget Sound, Wash., as per schedule 766.

WASHINGTON, D. C.—Consul-General William H. Michael, of Calcutta, reports that a British company having failed to install an electric light plant in Lucknow, India, according to the terms of the franchise granted about three years ago, the Council proposes to cancel the franchise and make other arrangements and has passed a resolution inviting bids for lighting the city by gas or electricity. For further information address No. 2915, Bureau of Manufacturers, Washington, D. C.

PENSACOLA, FLA.—Plans are being made by the Pensacola Investment Company to construct an electric railway from Pensacola to Magnolia Bluff. It is said that the company is now negotiating with Stone & Webster, of Boston, Mass., for the construction of the railway. It is proposed to connect with the system of the Pensacola Electric Company at some point on Sixteenth Avenue, and will run to Bayou Texas, crossing the bayou, passing through East Pensacola to Magnolia Bluff.

DALLAS, GA.—Bids are invited for the construction of a reinforced concrete dam and power house to be erected on Punking Vine Creek, four miles from Dallas, Ga., for the Paulding County Electric Company, the cost of which is estimated at $64,000. W. S. Lotus, of Dallas, is president; D. G. Zeigler & Company, of Atlanta, Ga., and Jacksonville, Fla., are consulting engineers.

JESUP, GA.—Bids are being asked for the construction of a reinforced concrete, cement and crushed stone dam and power house, and also for the construction of an electric railway 24 miles in length on Goose Creek, six miles north of Jesup, for the Goose Creek Railway & Power Company. The cost of the work is estimated at $600,000. D. G. Zeigler & Company, of Atlanta, Ga., and Jacksonville, Fla., are consulting engineers.

PALMETTO, GA.—Arrangements are being made for the installation of an electric light plant in Palmetto. B. W. Cochran is interested in the project.

LEWISTON, IDAHO.—It is reported that Spokane and Eastern capitalists, headed by Judge George W. Bolt and W. N. Bourke, of Spokane, Wash., are organizing a company to construct a local and interurban electric railway system and lighting plant in Lewiston, Idaho. The railway will be about 90 miles long. The cost of the electric light plant is estimated at $100,000 and the railway system, approximately, $7,500,000.

OROFINO, IDAHO.—The Orofino Electric Company is constructing a hydro-electric plant in Orofino. The cost of the plant is estimated at $10,000. F. J. Engelhorn is manager.

SANDPOINT, IDAHO.—Plans are being considered by the Humbird Lumber Company for the construction of two power plants in connection with its Sandpoint and Kootenai mills and a pumping station at Kootenai.

WHITE BIRD, IDAHO.—The plant and holdings of the White Bird Electric Company have been purchased by B. Davis, who, it is said, will install additional machinery. The plant is operated by water power.

BLOOMINGTON, ILL.—The McLean County Telephone Company is planning to complete the work of rebuilding its toll lines during the coming year, which will involve an expenditure of about $20,000.

CHICAGO, ILL.—The directors of the Chicago & Southern Traction Company have authorized an extension of the company's system from Kankakee, Ill., to Lafayette, Ind.

CHICAGO, ILL.—The Illinois Inland Traction Company has completed the survey and secured franchises and rights of way for its proposed railway from Crete to Momence, Ill., a distance of 20 miles. Work on construction of the road will commence early in 1909. W. H. Conrad, vice-president of the Chicago & Southern Traction Company, is one of the promoters of this project.

CHICAGO, ILL.—The Chicago, Milwaukee & St. Paul Railroad Company is in the market for the following equipment: One 48-in. draw cut crossing shaper, low down base and extra heavy swivel vise, complete with direct-current motor drive; one 36-in. x 12-in. by 12-ft. frog crossing plane, extra heavy cross rail and saddles to run approximately 26 ft. per minute with 3 to 1 return cut motor driven.

CHICAGO, ILL.—The Board of Trustees of the Sanitary District of Chicago has submitted a proposition to the Board of Education offering to supply electricity for lighting the school buildings at two cents per kw-hour. The city now pays the Commonwealth Edison Company 10 cents per kw-hour under a contract which does not expire until 1910. It is said if the Board of Education accepts a new contract which is now under consideration the company will furnish electricity for 3½ cents per kw-hour.

ELGIN, ILL.—The Council committee on gas and street lighting has completed its estimate for expenditures for the year amounting to $28,314, which includes 50 new street lamps at $42 each and $1,000 for additional lighting in the business and residence districts, $3,000 for gas testing machine.

GALVESTON, ILL.—The Kokomo Telephone Company has applied to

the Town Board for a franchise to establish a telephone service in Galveston, Ill.

HARMON, ILL.—Plans are being made by the Green River Telephone Company for the construction of a direct telephone line from Harmon to Amboy.

MONMOUTH, ILL.—It is reported that the Rock Island Southern Railroad Company will place contracts within 60 days for the construction of a power plant on Edwards River. The company will require two 1500-kw turbines and necessary boiler equipment. W. W. McCullough, of Monmouth, is general manager.

PAXTON, ILL.—Plans are being considered by the Paxton Electric Company to install a 20-ton ice plant on the property adjoining its power house. The company will also install early this year a complete ash-conveying system, and is also contemplating extending its transmission lines to Lodi, a distance of about four miles.

VANDALIA, ILL.—A certificate has been filed with the Secretary of State by the Vandalia Telephone Company showing an increase in the capital stock of the company from $15,000 to $50,000.

INDIANAPOLIS, IND.—The Merchants' Heat, Light & Power Company is planning to build an additional plant in the western part of the city, bids for the construction and equipment of which will be asked in the near future. Edward L. McKee is president.

KENTLAND, IND.—The Kentland Light & Ice Company is planning to construct a combined electric light, water and ice plant. Bids will soon be asked for the construction of the plant. Hugh Hill is president.

WARSAW, IND.—Plans are being made by the Commercial Telephone Company for the erection of a new circuit six miles in length.

BELLEVUE, IA.—Arrangements are being made to rebuild the municipal electric light plant immediately. The equipment will include an 85-hp suction producer gas engine, a three-phase 60-cycle 1100-volt generator. A direct-connected centrifugal pump will be installed to operate the water works system.

EAGLE GROVE, IA.—Arrangements are being made by the Citizens' Light & Power Company to establish a 24-hour service in Eagle Grove.

FAIRFIELD, IA.—It is said that the Fairfield Gas & Electric Company has withdrawn its proposition to furnish electricity to light the city and to operate the pumping station.

KEOKUK, IA.—The Mississippi Valley Telephone Company has filed amendments to its charter increasing its capital stock to $50,000.

PATON, IA.—The Hawkeye Telephone Company is planning to extend its telephone line from Perry to Paton.

GARDEN CITY, KAN.—Sargent & Lundy, Jackson and Michigan Boulevards, Chicago, Ill., consulting engineers, are reported to have been awarded the contract for the construction of the proposed power plant to be located in Garden City, by the Kansas-Colorado Power Transmission Company.

MOUNDRIDGE, KAN.—Bids will be received at the office of A. Ringwald, City Clerk, until Jan. 18, for furnishing material and constructing an electric light plant and water works system. Separate bids will be received as follows: 1. For furnishing material and labor (except cast-iron pipe, hydrants and valves, electrical machinery, pumping machinery, gasoline engines) and constructing water works and electric light system. 2. For furnishing cast-iron pipe and special castings. 3. For furnishing hydrants and valves. 4. For furnishing one 300-gal. per minute triplex power pump. 5. For generator, switchboard, transformers and arc and tungsten lamps. 6. For furnishing and erecting two 50-hp gasoline engines. 7. For furnishing material and erecting steel tower and tank 100 ft. high, having a capacity of 30,000 gal. The above material and work to be furnished in accordance with plans and specifications on file at the office of Burns & McDonnell, Scarritt Building, Kansas City, Mo. Anyone desiring extra copies of the plans and specifications may secure them from the engineers by making a payment of $5 to cover the cost of the prints.

LEXINGTON, KY.—The Midland Electric Company, recently incorporated, has taken over the franchise purchased from the city by Mr. Beckley.

SHELBYVILLE, KY.—The capital stock of the Shelbyville Water & Light Company has been increased from $20,000 to $40,000, the proceeds to be used for extension and improvements to its system.

BIDDEFORD, MAINE.—The Pepperell Company is making arrangements to install a 1500-kw, 600-volt Allis-Chalmers 60-cycle, turbo-generator set in its factory to furnish electricity to operate its plant. Additional boilers will be installed in the boiler plant.

CAMDEN, MAINE.—The Camden Water Power Company, recently incorporated, will utilize what is known as the Molineaux Mill privilege. The water power will be used to generate electricity, which will be utilized for lamps and motors. Work will commence at once on the project. E. Frank Knowlton is president of the company and C. W. Babb is treasurer.

LEWISTON, MAINE.—We are informed that surveys have been completed and the rights of way secured for the proposed electric railway to be constructed by the Portland, Gray & Lewiston Railroad Company. The railway will extend from Portland to Lewiston through Falmouth, Gray and New Gloucester. The officers of the company are: E. W. Gross, of Berlin, N. H., president; J. D. Clifford of Lewiston, Maine, vice-president; Charles C. Benson, of Lewiston, Maine, treasurer; J. A. Jones, chief engineer.

SACO, MAINE.—The York Manufacturing Company has ordered a steam turbo-generator set of the General Electric Company, Schenectady, N. Y., to be installed in its new plant, now being erected in Saco. Additional boilers will also be installed in the plant.

BALTIMORE, MD.—Edward Brady & Son, Baltimore, Md., have been awarded the contract for the construction of the new power house for St. Joseph's Hospital. The cost of the building is estimated at $15,000 and the equipment $10,000. The plant will furnish heat and light for the hospital.

BOSTON, MASS.—The contract for installing the electrical system in the schoolhouse on Moore Street, East Boston, Mass., has been awarded to the M. B. Foster Company for $4,844.

CLINTON, MASS.—The Gibbs Loom Harness & Reed Company has recently installed a Phoenix generator in its plant to provide electricity for lighting the factory.

MANSFIELD, MASS.—The Board of Commissioners has voted to substitute 250-watt, 5.5 amp tungsten series lamps for street series arc lamps now in use here. All of the arc lamps will be discarded.

METHUEN, MASS.—The Southern New Hampshire Street Railway Company is contemplating the construction of a new power station in Methuen. At present electricity for operating the system is transmitted from the power plant at Portsmouth, N. H.

PITTSFIELD, MASS.—The Board of Aldermen has granted the Pittsfield Street Railway Company a franchise to double track its lines from Park Street to Pontoosuc Lake.

ALLEGAN, MICH.—Arrangements are being made by the Trans-Michigan Street Railroad Company for the construction of its proposed railway, which will connect Allegan and South Haven, Mich., a distance of about 30 miles. The power plant and repair shops will be located in Allegan. William Pyatt, of Chicago, Ill., is president.

LANSING, MICH.—The Western Michigan Power Company has been granted a franchise by the Township Board to erect its transmission lines in Lansing. The company has also secured rights of way in Calhoun, Eaton, Kalamazoo and other southern counties. The headquarters of the company are at Cadillac, Mich.

SOUTH HAVEN, MICH.—The Chicago, Benton Harbor & Grand Rapids Railroad Company has been granted a franchise to construct an electric railway through South Haven. Joseph W. Hosmer, William E. Dodson and George S. Hannaford, of Chicago, Ill., are interested in the enterprise.

WYANDOTTE, MICH.—Preparations are being made by the Interstate Telephone Company to install an exchange in Wyandotte, Mich.

HOKAH, MINN.—Plans are being considered by the new owner of the Weber flour mill to install an electric light plant in connection with the mill and furnish electric lighting service in the town.

RENVILLE, MINN.—The construction of an independent telephone system in Renville is under consideration by the business men of the town.

STILLWATER, MINN.—A new telephone company has been organized by the farmers south of Stillwater Junction with the following officers: Edmund Wolff, president, and R. O. Ulrick, secretary and treasurer.

COLUMBIA, MO.—Application has been made to the City Council by J. W. Grain and others for a franchise to construct telephone lines in Columbia in connection with the erection of a rural telephone system between Columbia and other points in this vicinity.

JEFFERSON, MO.—A. T. Sparta, of New York, N. Y., is reported to be interested in a project to construct an electric railway from Jefferson City to Columbia, Mo., via Fulton.

KANSAS CITY, MO.—The Oklahoma & Golden City Railway Company contemplates the construction of an electric railway connecting Springfield, Mo., Pawhuska, Okla., and Jefferson City, Mo. The overhead trolley system will be used. W. K. Palmer, Dwight Building, Kansas City, Mo., is chief engineer. Winfield S. Pope, of Jefferson City, Mo., is president.

MAYSVILLE, MO.—The City Council has granted a franchise to W. T. Wingate to operate an electric light system in Maysville.

MISSOURI VALLEY, MO.—A contract has been made by J. E. Jones, W. M. Jones, Homer E. Jones, Bernard C. Jones and E. E. Jones with William Hayes, manager of the Missouri Valley Light Company, for material for the installation of a complete electric light plant to supply electricity for their farms.

ST. LOUIS, MO.—Bids will be received at the office of the Board of Public Improvements, New City Hall, St. Louis, Mo., until Feb. 5, for furnishing electricity for lighting certain public buildings, lighting streets, avenues, boulevards, parks and other public places of the city of St. Louis.

TIFFIN, MO.—Plans are being made by the El Dorado Springs, Tiffin, Monegaw Springs & Lowry City Railroad Company to commence work on the construction of its proposed electric railway. The railway will consist of about 30 miles of track and the overhead trolley system will probably be adopted. The power station will be located on the Osage River. Dr. C. A. Edgar, of El Dorado Springs, Mo., is president, and J. S. Harrison, of Tiffin, Mo., secretary and general manager.

MISSOULA, MONT.—W. A. Clark has been granted a 99-year franchise by the Board of Aldermen of the new town of Shangville to construct and operate an electric railway in the town.

VICTOR, MONT.—The Bitter Root Telephone Exchange Company is planning to install exchanges at Victor and Corvallis.

ALBION, NEB.—The citizens are considering the question of establishing a lighting and heating system in Albion. An election will soon be held to vote on the proposition to issue bonds to install the plant.

ST. EDWARD, NEB.—The question of establishing an electric light plant in this town is under consideration.

BELLEVILLE, N. J.—James M. Seymour, Jr., representing the Newark Block Lighting Company, has notified the Township Committee that his company will make application for a franchise if the committee would consider the proposition. The company proposes to construct a plant, provided a 20-year franchise is granted.

HOBOKEN, N. J.—The Mutual Electric Light & Power Company, of Newark, N. J., has applied to the City Council for a franchise to lay conduits in the city for the distribution of electricity in Hoboken. The company agrees to place all its wires underground and to furnish electricity at a maximum rate of eight cents per kw-hour and to give a discount of five per cent on all bills paid within five days. In return for the franchise the company offers to pay to the city three per cent of its gross earnings. James M. Seymour, Jr., of Newark, is president of the company.

MORRISTOWN, N. J.—Plans are being made by the Morris County Traction Company to place contracts for the construction of a new central power station, together with three substations, during the next six weeks; also for the construction of about 20 miles of track.

SANTE FE, N. M.—The Santa Fé Electric Telephone Company has commenced work on the installation of a cable system throughout the city and will soon commence work on the erection of toll lines to Espanola and Lamy.

BALLSTON SPA, N. Y.—The Board of Trustees has renewed the contract for street lighting with the Ballston Spa Light & Power Company for a term of two years.

DUNDEE, N. Y.—Arrangements are being made by the owners of the Dundee electric light plant to sell, charge and care for electric vehicles in the near future. We are informed that the town is making liberal offers of factory sites with other inducements for manufacturing purposes.

FILLMORE, N. Y.—The Public Service Commission of the Second District has authorized the Genesee Valley Power Company, of Fillmore, to issue bonds to the amount of $18,000, the proceeds to be used for payment of outstanding notes of the company and for acquisition of property and for extension and completion of its system.

GENEVA, N. Y.—Bids will be received until Jan. 18 by L. P. Haviland, chairman of the Building Committee of the New York State Agriculture Experiment Station, Geneva, N. Y., for furnishing switchboard and feeder, cables, motors and interior wiring for four staff residences at the New York State Agriculture Experiment Station, Geneva, N. Y. Drawings and specifications may be consulted and blank forms of proposal obtained at the New York State Agriculture Experiment Station, Geneva, N. Y., or at the office of Franklin B. Ware, State Architect, Albany, N. Y.

HUNTINGTON, N. Y.—Work has commenced on the proposed extension of the plant of the Huntington Light, Heat & Power Company, which will include the installation of a 300-kw, 60-cycle, two-phase, 2400-volt, Westinghouse Parsons turbo-generator set, making the total output of the plant 450 kw. The improvements as now planned will cost from $20,000 to $30,000.

KATONAH, N. Y.—The Katonah Light Company has been granted permission to issue capital stock to the amount of $10,000 by the Public Service Commission of the Second District, the proceeds to be used for extensions and improvements to its plant.

LESTERSHIRE, N. Y.—An electric power plant has been installed in the Faatz-Reynolds Felting Works to furnish electricity for operating the entire plant.

MIDDLETOWN, N. Y.—The capital stock of the Orange County Telephone company has been increased from $10,000 to $50,000.

NEWBURGH, N. Y.—The Poughkeepsie Light, Heat & Power Company has assigned to the Newburgh Light, Heat & Power Company all its interests in right of way in the town of Marlboro from the town of Lloyd to the village of Marlboro; also the site in Marlboro for a substation.

NEW YORK, N. Y.—The contract for installing electric equipment in School No. 114 on James, Oak and Oliver Streets, Borough of Manhattan, has been awarded by C. B. J. Snyder, Superintendent of School Buildings, to Cowden & Young, of New York, N. Y., for $13,893.

ONEIDA, N. Y.—It is reported that a movement is on foot to organize a light and power company with a capital stock of $100,000. It is said that a meeting will be called immediately after the holidays when some definite action will be taken.

SCHENECTADY, N. Y.—We are informed that the Schenectady Power Company does not contemplate the construction of a dam on the Walloomsac Creek, near Walloomsac, as reportted in the issue of Jan. 2.

SENECA FALLS, N. Y.—The Geneva, Waterloo, Seneca Falls & Cayuga Lake Traction Company has been granted a franchise by the Town Board to extend its railway from the east line of Seneca Falls to the west short of Seneca Lake, along the highway. The company has also been granted a franchise to extend its railway through Aurelius.

CARTHAGE, N. C.—Plans are being made by the Carthage Telephone Company for the extension of its telephone lines to Bensalum, Big Oak, Eagle Springs and Biscoe.

LEXINGTON, N. C.—The directors of the Decotah Cotton Mills, recently incorporated, are planning the construction of a cotton mill with a capacity of 10,944 spindles and accompanying looms. Both steam and electricity are being considered for motive power.

MEDORA, N. D.—Franchises have been granted to the Dakota & Montana Telephone Company and to the Northern Telephone Company to erect and maintain telephone systems in Billings County.

BUCYRUS, OHIO.—It is reported that the electric light company has offered its plant to the city for $35,000.

CADIZ, OHIO.—Surveys are nearly completed and arrangements being made for the construction of the proposed electric railway of the Wheeling, Cadiz & Tuscarawas Traction Company, connecting Uhrichsville, Cadiz, Martins Ferry, Wheeling, W. Va., and intervening towns. The railway will consist of 55 miles of track. The power station will be located at Cadiz, and will furnish electricity for lamps and to manufacturing concerns along the route. A. E. Townsend, of Cadiz, Ohio, is president and general manager.

CINCINNATI, OHIO.—The Cincinnati & Suburban Bell Telephone Company has instructed Architect Harry Hake to prepare plans for a branch exchange building in Avondale.

CINCINNATI, OHIO.—Plans have been filed by the Cincinnati Traction Company for a new power house to be erected on Keck Street between Foster and St. Andrews Street. The cost of the building is estimated at $32,000.

McCOMB, OHIO.—Plans are being considered to install a 100-kw 250-volt direct-current generator in the municipal electric light plant. C. S. Hoskinson is manager.

RICHWOOD, OHIO.—The Council on Dec. 24 turned down the petition, containing the names of 250 taxpayers, asking that an election be held to vote on the proposition to establish a municipal electric light plant for Richwood. The town has been without a street lighting service for some time.

WARREN, OHIO.—The Hydro-Electric & Gas Company has completed its two dams at Newton Falls and has commenced work on rebuilding the cofferdam at Leavittsburg, which was recently washed out.

WARREN, OHIO.—Under a compromise arrangement, the City Council has agreed to amend the franchises granted the Hydro Electric Company and the Warren Water & Light Company in such a way that they will not be required to pay into the city treasury 1 per cent a month of their gross earnings.

EUGENE, ORE.—Proposals will be received until Jan. 11 for the construction of a 2400-hp plant on the McKenzie River to furnish power for pumping water from the river to Eugene.

MARSHFIELD, ORE.—The Coos Bay Railway & Terminal Company, recently incorporated, is planning to commence work on the construction of its railway in the spring. According to the present plans, the railway is to extend from North Bend to Marshfield and then on to Millington and from North Bend across Pony Inlet to Sunset Bay, which is being made into a summer resort. The power plant for operating the system is located at Porter, half way between North Bend and Marshfield. The plant is nearly completed and is designed to furnish electricity for lamps both in Marshfield and North Bend as well as for operating the railway. Henry Hewitt, of Tacoma, Wash., is president, and Seymour H. Bell is treasurer and manager.

PORTLAND, ORE.—Mayor Lane in his annual address recommended an appropriation of $190,000, the proceeds to be used to establish a distributing system to furnish electricity for street lamps. If it is decided to erect a system, the city will purchase electrical energy to operate the same.

WILLAMETTE, ORE.—The Willamette Improvement Association has adopted resolutions endorsing Mayor Lane's attitude toward the construction of a municipal electric light plant.

CONNELLSVILLE, PA.—Plans are being made by the West Penn Electric Company to erect a power plant in Fayette County at a cost of about $1,500,000. The plant will be a duplicate of the power station at Fayette and will have an output of about 22,000 hp. The power station will probably be located in the southern part of Fayette County near the Monongahela River. The plant will furnish electricity for the West Penn Railways Company's system. L. H. Conklin, of Connellsville, Pa., is general superintendent.

MALVERN, PA.—The Ridley Creek Supply Company contemplates the installation of a producer gas plant, additional generators and the extension of its transmission lines to Frazer, Pa.; also establishing a 24-hour service. George W. Fowler & Company, of 30 Broad Street, New York, N. Y., are general managers. George L. Dutton, superintendent.

PHILADELPHIA, PA.—Plans are being considered by the merchants of Cohocksink to extend and improve the lighting system of the Cohocksink section. The question has been taken up by the lighting committee with the City Council and an official of the Philadelphia Electric Company and a scheme outlined for installing many additional lamps.

PHILADELPHIA, PA.—The Royalton & Elizabethtown Street Railway Company, it is said, will commence work on the construction of its proposed electric railway, connecting Middletown, Royaltown, Elizabethtown, Florin and Mount Joy. A branch railway will also be built to Lebanon. The road will be 40 miles long and the overhead trolley

system will be adopted. The power plant will be located in Conewago and will furnish electricity to towns along the route. William Trimble, of Minneapolis, Minn., is president. Headquarters are at 1324 Real Estate Trust Building, Philadelphia, Pa.

PHILADELPHIA, PA.—The City Council has granted the Delaware Tunnel Railroad Company a franchise to construct a tunnel under the Delaware River. The company has already secured the necessary legislation in New Jersey. Beginning at Market and Second Streets, on the Philadelphia side, one tube will extend to Chestnut Street and thence across the river to Third Street in Camden. The north tube will extend from Third Street in Camden across the river to Second and Arch Streets in Philadelphia and will join the first tube at Market Street. The combined mileage will be a little over four miles.

SOMERSET, PA.—Application will be made Jan. 11 for a charter for the Somerset Street Railway Company by John A. Berkey, Frank B. Fluck, Clarence L. Shaver, James C. McSpadden, John C. Lowry, A. L. G. Hay and A. K. Miller. The company proposes to construct and operate a street railway from Rockwood to Somerset.

WEST LEESPORT, PA.—The Rural Telephone Company is planning to build a telephone line from West Leesport to Reading. Harry B. Adam, of Leesport, and Edwin Kauffman, of West Leesport, are interested in the enterprise.

WILLIAMSPORT, PA.—The Citizens' Electric Company contemplates increasing the output of its plant and will install additional equipment, including boilers, engines and generators. Jonas Fischer is president and manager.

YOUNGSTOWN, PA.—The contract for furnishing electricity for lighting the streets and public buildings in Youngstown, Pa., has been awarded to the West Penn Electric Company, of Connellsville. The company will extend its transmissioon lines at once to this city, and will also furnish electricity for lamps and motors for commercial and private consumers.

PONCE, P. R.—The contract for constructing the municipal electric light plant in Ponce has been awarded to Bellman & Sanford, 149 Broadway, New York, N. Y., for $23,630.

PASCOAG, R. I.—The citizens have voted to authorize the operating committee to secure the services of an electrical engineer to investigate the municipal electric light plant and ascertain the cost of remodeling the plant so as to improve the service.

BLACKSBURG, S. C.—The citizens on Dec. 21 voted to issue $15,000 in bonds, the proceeds to be used for the construction of an electric light plant and other purposes. P. H. Freeman is chairman of Public Works Commission.

CHARLESTON, S. C.—Bids will be received by J. H. Dingle, city engineer, until Jan. 20 for one 450 gal. per minute vertical centrifugal pump, with electric motor for operating the same.

ST. MATTHEW, S. C.—Bids are being asked for the construction of 50 miles of electric railway and a reinforced concrete dam and power house for the Calhoun Railway & Power Company, to be located on High Hill Creek, six miles north of St. Matthew. The cost of the work is estimated at $800,000. D. G. Zeigler & Company, of Atlanta, Ga., and Jacksonville, Fla., are consulting engineers.

DEADWOOD, S. D.—The Burlington Railroad is making arrangements to install a telephone system in the Black Hills. The company operates nearly 200 miles of road in the Hills.

RAPID CITY, S. D.—The Rapid City & Wyoming Railway Company has been granted a franchise to construct and operate a street railway in Rapid City, which will be several miles in length. The company is authorized to use either gasoline or electric motors for motive power.

SIOUX FALLS, S. D.—Plans are being made by the Sioux Falls & Sioux City Electric Railway Company to begin work on construction of its proposed railway some time this year. The railway will be about 90 miles in length and will connect Sioux Falls, S. D., and Sioux City, Ia., and intervening towns. The present plans call for the construction of two power stations, one to be located at Sioux Falls, S. D., and the other at Sioux City, Ia. George W. Burnside, of Sioux Falls, S. D., is general manager.

HENNING, TENN.—A new telephone line, known as the Mac Telephone Company, is being erected from Mac to Glimp, where it will connect with the Cumberland Telephone Company's line.

MEMPHIS, TENN.—It is reported that the Trustees of the City Hospital contemplate the installation of a light plant.

MEMPHIS, TENN.—Work has commenced on the construction of the new interurban electric railway between Memphis and Lakeview, a distance of 12 miles. This line is to be part of the plan of the Clarksdale, Collierville & Covington Company, which proposes to operate a system of electric interurban railways to a number of smaller towns, all centering at Memphis. Motor cars will be operated during the coming summer and until the electric plant is completed. H. E. Craft is interested in the project.

WALLAND, TENN.—Arrangements are being made by the Schlosser Leather Company to change the motive power of its plant from steam to electricity. About 160 hp will be developed and will include the construction of a concrete dam 150 ft. long, 11 ft. high, across the Tennessee River, three-quarters of a mile below Walland. The cost of the work is estimated at $15,000. The contract for the work has been awarded to the Eastern Construction Company. W. A. P. Schorman will have charge of the work.

FORT WORTH, TEX.—The Northern Texas Traction Company is extending its system to Washington and Fostepeco Heights and adjacent communities. The extension will be about two miles long. H. T. Edgar is general manager.

WICHITA FALLS, TEX.—The Southwestern Telegraph & Telephone Company is planning to install a telephone system in Wichita Falls, at a cost of about $30,000.

OGDEN, UTAH.—The directors of the Ogden Rapid Transit Company are contemplating the extension of several of its interurban lines, including an extension through Ogden Canyon and on to Huntsville and Eden Valley.

RICHMOND, VA.—The joint committee on water and electricity of the Council has adopted the recommendation of a subcommittee for converting the old pump house into an electric light and power plant, according to the plans and specifications submitted by E. W. Trafford, consulting engineer.

SOUTH HILL, VA.—The city is considering the question of granting a franchise for the construction of an electric light system in South Hill. For further information address Mack Pritchett, clerk.

SOUTH HILL, VA.—We are informed that a telephone and electric light franchise will be sold Jan. 18 to the highest bidder. Mack Pritchett is clerk of the Council.

ABERDEEN, WASH.—The Grays Harbor Railway & Light Company has decided to extend its transmission lines to Cosmopolis and South Aberdeen to furnish electricity for lighting both towns. The cost of the work is estimated at between $10,000 and $15,000, work on which will begin soon.

CHEHALIS, WASH.—The City Council has granted a 35-year franchise to W. J. Patterson, Theodore Hoss and A. Welch to construct and operate an electric railway in Chehalis. Under the terms of the franchise the company is to have free use of the streets for the first five years; the following 20 years the company is to pay the city the sum of $250 per year and for the last 10 years of the franchise $500 per annum. The same parties have already secured a franchise in Centralia, Wash.

KENNEWICK, WASH.—The Columbia Basin Light & Power Company has applied to the City Council for permission to erect a high-tension transmission line from its plant to Washington Street and thence to Garden Tracts.

PUYALLUP, WASH.—Plans are being made to commence work on the construction of a new substation in Puyallup for the Puget Sound Electric Railway and the Tacoma Railway & Power companies. The cost of the station complete is estimated at from $35,000 to $40,000.

SPOKANE, WASH.—Rights of way are now being secured by the Spokane, Columbia & Western Railway Company for its proposed railway, which is to extend from Spokane to Reardan, Davenport and Peach, a distance of about 70 miles. The railway when completed will be operated as part of the Spokane & Inland Railroad. Clyde M. Graves, of Spokane, is president.

TACOMA, WASH.—The report of the city controller on the municipal electric light and power plant shows a profit of $90,000 for the past year. According to the report the charges against the plant are as follows: For electrical energy purchased, $110,000; cost of operation, $75,000; cost of repairs, $20,000; interest on investment of $875,000, $40,000, making a total of $245,000 for the year. Receipts are as follows: For electricity sold to private customers, $281,000; electricity furnished for street lamps and public buildings, $54,000, making the total $335,000, which gives the city a profit of $90,000.

CLARKSBURG, W. VA.—Dr. George I. Keener has been granted a 50-year franchise by the County Court to construct and operate an electric railroad from Weston to Bendale.

PARSONS, W. VA.—Contracts have been placed by the Cheat Valley Telephone Company for the construction of a telephone line between St. George and Kingwood.

WELLSBURG, W. VA.—Arrangements are being made by the Wellsburg, Bethany & Washington Traction Company to extend its railway from Bethany to Washington, Pa., a distance of about 21 miles.

BRISTOL, WIS.—The Bristol Telephone Company has increased its capital stock from $3,000 to $8,000.

EDGERTON, WIS.—Application has been made to the City Council by the Cincinnati Construction Company for a franchise to construct and operate an interurban or an electric street railway on certain streets of the city.

HUDSON, WIS.—The Northwestern Telephone Exchange Company has sold all its holdings in the State of Wisconsin to the Wisconsin Telephone Company, which assumed control Jan. 1, 1909.

JEFFERSON, WIS.—The municipal electric light plant was put into operation Dec. 25. A 24-hour service will be established.

KENOSHA, WIS.—Plans are being considered by the Chicago, Kenosha & Milwaukee Electric Railway Company to construct an interurban railway connecting Waukegan, Kenosha, Racine and Milwaukee. The company has applied to the State Railroad Commission at Madison, Wis., for permission to construct an electric railway from Kenosha to the State line and is also securing rights of way through this city. The officers of the company are: George G. Wilcox, president; Volney Foster, Jr., of Evanston, vice-president, and Frank Grover, secretary and treasurer.

KILBOURNE, WIS.—The Central Wisconsin Transit Company is planning to commence work on the construction of its proposed railway early this spring. Burns & Company, of Isabella Building, Chicago, Ill., have been awarded the general contract for the construction of the road. The railway will be about 65 miles in length and will connect Kilbourne, Portland, Friendship and Grand Rapids, Wis. Both steam and electricity will be used for motive power. J. J. Burns, of Chicago, Ill., is president and general manager.

RIVERSIDE, WIS.—Arrangements are being made by the J. M. Kohler & Sons Manufacturing Company to install individual motors to operate its plant at a cost of $15,000. The contract for a switchboard has been awarded to Acker & Schiffendor, of Sheboygan, Wis., for about $4,000.

WAYSIDE, WIS.—The Wayside Telephone Company contemplates extending its telephone line through Maple Grove.

EDMONTON, ALB., CAN.—The Preston Car Company, of Preston, Ont., has been awarded the contract to supply cars for the municipal electric railway system at $3,225, f. o. b. this city. With the motors the cars will cost $5,400 apiece. The tenders without motors ranged from $3,225 to $4,985.

ARMSTRONG, B. C., CAN.—The City Council has decided to purchase the electric lighting plant of the Armstrong Electric Light & Power Company and to operate it as a municipal enterprise.

VANCOUVER, B. C., CAN.—James D. Schuyler, of Los Angeles, Cal., has recommended that the British Columbia Electric Railway Company build a dam 75 ft. high at the mouth of Coquitlam Lake to form a large reservoir and thereby increase its power supply very materially.

RUSSELL, MAN., CAN.—The Russell Telephone Company has increased its capital stock from $5,000 to $25,000, the proceeds to be used for extension to its system.

WINNIPEG, MAN., CAN.—The Winnipeg Electric Company has offered to supply the city with all the power required for civic and other purposes for $24.66 per horsepower per year, permitting the city to fix any rate it pleases with the consumers. The matter has not yet been taken up by the City Council, but a number of Aldermen have stated that the offer will not be considered, as the Council is pledged to municipal ownership. F. E. Cambridge is city electrician.

SYDNEY, N. B., CAN.—N. J. McLean, of Fourchu, N. B., has commenced a survey for the proposed electric railway to extend from Sydney to East Bar.

HALIFAX, N. S., CAN.—The Wentworth Home Telephone Company has been granted a franchise to construct about 35 miles of telephone lines in Wentworth County.

BRANTFORD, ONT., CAN.—Plans are being made by the Brantford Street Railway Company to remodel its entire system and also to construct an extension from Brantford to Dover within a few months.

FREELTON, ONT., CAN.—Malcolm McPherson, of Freelton, has been appointed to purchase the right of way for the proposed electric railway to run between Freelton and Guelph. For further information address John Patterson, of Hamilton, Ont.

ORILLIA, ONT., CAN.—Since the completion of the dam at Ragged Rapids the town has made material reduction in its charges for electricity for lamps furnished by the municipal plant. In future the charges for commercial lighting will be from 28 cents to 18 cents per month per lamp, and for residences from 20 cents to 18 cents.

OTTAWA, ONT., CAN.—A charter is being applied for for an electric railway to run from Ottawa to Morrisburg, a distance of 143 miles. The estimated cost of railway is $2,000,000. For further information address C. S. Cossitt, of Brockville, Ont.

SUDBURY, ONT., CAN.—The Ontario Railway and Municipal Board has approved a by-law of the Town of Sudbury providing for an expenditure of $19,000 for extensions to the water works and electric light plants.

TORONTO, ONT., CAN.—The Government will appoint a telephone commissioner, owing to the large number of rural telephone companies being incorporated.

TORONTO, ONT., CAN.—The Hydro-Electric Power Commission promises to deliver power to this city by Dec. 19, 1909. K. L. Aitkin is engineer in charge of the city's interests.

WELLAND, ONT., CAN.—G. H. Burgar, of Welland, is endeavoring to secure a franchise for an electric railway company to build several lines in the vicinity of Welland.

EMARD, QUE., CAN.—The St. Paul Electric Power Company, of Montreal, has purchased the local electric lighting plant, owned by J. L. Marchand, for $149,000. The plant was built two years ago and holds a 30-year franchise.

SASKATOON, SASK., CAN.—The Northwestern Telephone Company has issued additional stock to the amount of $25,000, the proceeds to be used to assist in the formation of rural telephone companies. The company has decided not to engage in the construction of long-distance lines, leaving it entirely to the Saskatchewan Government.

New Industrial Companies.

THE ELECTRIC SHADED SIGN COMPANY, of North Yakima, Wash., has been chartered with a capital stock of $30,000 by Henry Schott, John Hulse and James E. Merwin.

THE PHILADELPHIA MULTIPHONE COMPANY, of Philadelphia, Pa., has been chartered with a capital stock of $100,000 by A. P. Pitner, G. W. Codar and D. B. Wilwar, of Philadelphia, Pa.

THE AURORA ELECTRICAL COMPANY, of Aurora, Ill., has been chartered with a capital stock of $2,500 to deal in electrical goods. The incorporators are: F. L. Beesaw, T. J. Merrill and F. W. Hartsburg.

THE TRI-CITY ELECTRIC COMPANY, of Moline, Ill., has filed articles of incorporation with a capital stock of $50,000. The company is an Iowa corporation doing an electrical contracting and manufacturing business.

THE FIDELITY ELECTRIC CONSTRUCTION COMPANY, of New York, N. Y., has been chartered with a capital stock of $2,000 by Harry Barth, Leo Weiss and Ida Bernstein, all of New York, N. Y. The company proposes to do a general electrical construction business and mechanical equipment.

THE SOUTHWESTERN CONTRACTING & ENGINEERING COMPANY, of New York, N. Y., has been chartered with a capital stock of $30,000 by Harry Peel, Henry J. Wallach and Marvin E. Parrott, all of New York, N. Y. The company proposes to do a general engineering and contracting business.

THE AMERICAN-CHINESE ENGINEERING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000, to do engineering work in America and China. The incorporators are: Theodore M. Foote, of Brooklyn, N. Y.; Frank Lee Lowe and Goon Chung, of New York, N. Y.

THE METAL GOODS MANUFACTURING COMPANY, of Portland, Maine, has filed articles of incorporation with a capital stock of $10,000 and the following named officers: C. L. Marston, president and clerk; C. J. Lawrence, both of Yarmouth, Maine. The company proposes to manufacture electrical and mechanical apparatus.

THE PRATT ENGINEERING COMPANY, of Atlanta, Ga., has been incorporated with a capital stock of $700,000 by N. P. and George L. Pratt, George F. Hurt and others. The company proposes to engage in all branches of engineering work, contracting and construction, manufacturing machinery, and equipment and construction of electric and steam railways.

THE OVERHEAD & UNDERGROUND CONSTRUCTION COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $3,000. The incorporators are: Joseph W. Putnam, of East Orange, N. J.; Charles A. Florence, of New Rochelle, N. Y., and Walter M. Whitney, of New York, N. Y. The company proposes to carry on a general contracting and engineering business.

New Incorporations.

PHOENIX, ARIZ.—Articles of incorporation have been filed for the Phoenix, Tempe & Mesa Railway Company. The directors are: S. J. Tribolet, L. M. Hoghe, I. Diamond, Andre W. Neilson, Harry J. Bennett, M. L. Vieux and George Hageman.

DANVILLE, ARK.—The Danville Electric Company has been incorporated by D. F. Montgomery, A. M. Falls, C. T. Meadors, George Leming, I. R. Graydon, C. C. Sharpe, W. T. Blackburn and others. Officers: D. F. Montgomery, president; I. B. Graydon, vice-president; George Leming, secretary; A. M. Falls, treasurer. The object of the company is to furnish electricity for light and power for the city and to establish a water works plant.

TURLOCK, CAL.—The Turlock Home Telephone & Telegraph Company has been formed to operate a local telephone exchange. The officers are: John L. Randolph, president; J. C. Williams, vice-president; A. J. Eddy, secretary; H. T. Adams, treasurer, and W. T. Thornburg, manager.

FAIRBURN, GA.—The Fairburn & Atlanta Railway & Electric Company has been incorporated, with a capital stock of $75,000, to construct an electric interurban railway from Fairburn through Stonewall and Red Oak to College Park, a distance of about 11 miles. The incorporators are: J. F. Golightly, of Atlanta, Ga.; W. T. Roberts, J. H. Harris, W. H. Mims, L. M. Hobgood, J. E. Longino, J. H. Longino, W. H. McLarin, D. A. Carmichael, all of Fairburn, Ga.

REUBENS (P. O. KIPPEN), IDAHO.—Articles of incorporation have been filed for the Reubens Rural Telephone Company, with a capital stock of $2,000, by James Bonnallie and others.

WAUKEGAN, ILL.—The Waukegan, Rockford & Elgin Traction Company has been formed to construct an electric railway from Waukegan to Marenga, work on which will begin early this year, and later to build a branch from Fox Lake to Elgin. The cost of the first project is estimated at $1,500,000. The promoters are: J. L. Pope, who, it is said, will be president of the company; Paul McGuffin, of Libertyville; J. C. Foley, Theodore H. Durst, Claire C. Edwards and R. D. Wynn, all of Waukegan, Ill.

CLYDE, IA.—Articles of incorporation have been filed for the Farmers' Telephone Company, with a capital stock of $400, by George Gilbertson, James E. Moore and Frank Baker.

ELDORADO, KAN.—The Eldorado Light & Water Company has been incorporated at $50,000. The company proposes to purchase and equip a lighting plant at Eldorado. John P. Holmes is president of the company. Incorporators include John F. Holmes, S. H. Morgan and J. J. Hudson, all of Eldorado.

LEXINGTON, KY.—The Midland Electric Company has filed articles of incorporation, with a capital stock of $100,000. The company proposes to generate and distribute electricity for lamps, heat and motors, also steam or hot water for heat, in the city of Lexington and other places in the State. The incorporators are: Warren E. Griffin, of Philadelphia, Pa.; Pendleton Beckley, of Louisville, Ky.; Arthur Lipper, of New York, N. Y.; J. E. Cope Morton, of Devon, Pa., and Norton M. Griffith, of Philadelphia, Pa.

SCIENCE HILL, KY.—The Science Hill Telephone & Exchange Company has been chartered, with a capital stock of $800, by William Lowery, T. W. Denney, A. Y. Hayes and others.

Legal.

ENJOINED FROM ERECTING ELECTRIC PLANT.—In the test case brought against the Board of Public Service of Lima, Ohio, to enjoin it from erecting an electric light plant, Judge Killits, of Bryan, has handed down a decision, in which he holds that the board is exceeding its power in attempting to contract for an incomplete or inoperative plant and trusting that the pressure of necessity or the favor of the City Council will result in procuring more funds to finish the plant. The board is enjoined from erecting a plant under the present plans, upon which bids have been received, but is granted the right to prepare new plans so that the cost may come within the limits of the funds at its disposal.

AUTOMOBILE IGNITION.—It appears that steps have been taken by the Apperson Brothers' Automobile Company, of Kokomo, Ind., of which Elmee Apperson is president, to notify all manufacturers and importers of and dealers in automobiles in this country of the existence of his two patents in connection with the manufacture of internal explosion motors. The first patent has been held by Mr. Apperson for some time and the second was granted to him on the 1st of December. Both patents have to do with the ignition of motors, and, it is declared by Mr. Apperson, cover broadly the use of two or more separate igniting devices provided with separate circuits with means of throwing the ignition devices into or out of action simultaneously or independently.

Obituary.

MR. JEROME CARTY.—The death is announced in Philadelphia on Dec. 30 of Mr. Jerome Carty from a second stroke of apoplexy, the original attack of which seized him several months ago while he was West. He is survived by a son, Harry Carty, and a daughter, Mrs. F. A. Baird. Mr. Carty was born Oct. 20, 1845, at Springfield, Pa. He graduated in law from the University of Pennsylvania in July, 1866. He was confidential assistant of Charles Henry Lex until 1872, when he began practice for himself. He handled coal land sales involving many millions for various estates. Mr. Carty occupied a prominent position in Europe and the United States in the telephone litigation in opposition to the Bell company, taking an active part in various arguments in which he was associated with Col. Robert G. Ingersoll. From time to time he was interested also in other electrical litigations and projects.

Personal.

MR. JOHN J. CARTY, chief engineer of the American Telephone & Telegraph Company, is at present on the Pacific Slope and is not expected to return East for several weeks.

MR. JOSEPH C. GRAVES, who for 15 years was associated with the Otis Elevator Construction Company, has resigned and will become vice-president of the American Elevator Company.

MR. MAURICE QUAIN, formerly with the Cranbrook Electric Light Company, Cranbrook, B. C., has been appointed superintendent of Kootenay Telephones, Ltd., with head office at Cranbrook, B. C.

MR. W. N. RYERSON, for several years superintendent of the Ontario Power Company, Niagara Falls, Ont., has resigned to accept a position as manager with the Great Northern Power Company, of Duluth, Minn.

MR. E. F. GARDNER, manager of the Shore Electric Company, of Red Bank, N. J., has accepted the position as general manager of the New Jersey Consolidated Water & Light Company, at Deal Beach, N. J.

MR. ROBERT C. HOUSE, who was superintendent for M. W. Forney Company, New York, has resigned and entered the sales department of the Safety Insulated Wire & Cable Company, 114 Liberty Street, New York City.

MR. JOHN B. GUTHRIE will hereafter be the sole representative of the American Steam Gauge & Valve Mfg. Company, of Boston, Mass., in the Pittsburg district, and will have offices in the Columbia Bank Building, corner of Fourth Avenue and Wood Street, Pittsburg.

MR. D. D. PENDLETON, who was connected with the Westinghouse Electric & Manufacturing Company, of Pittsburg, for some fifteen years, has recently opened an office as district sales manager of the American Boiler Economy Company, manufacturers of the Copes feed water regulator and the Copes pump governor. His offices are located in the Frick Building Annex, Pittsburg, Pa.

CONNELL & CONNELL.—The copartnership of Connell, Sykes & Connell, heretofore doing business at 90 West Street, New York City, as consulting engineers, has by mutual consent been terminated by the retirement of Mr. H. W. Sykes. Messrs. H. W. Connell and H. F. Connell, heretofore of the said firm, have formed a partnership under the firm name and style of Connell & Connell, and will continue as consulting engineers at the same address.

Calendars.

THE COOPER HEWITT ELECTRIC COMPANY, Pittsburg, Pa., has issued a three-months' calendar, intended particularly for the manufacturer. It gives timely hints as to the installation and operation of mercury-vapor lamps.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, following the practice which it established some years ago is distributing to its various customers very artistic calendars for 1909, which are attractive enough to merit a place on the walls of any office to which they may be sent.

STUART-HOWLAND COMPANY is distributing among its customers a calendar of large size, which instead of the usual picture has a map of the world, showing the principal steamship routes, with a border of the flags of all nations in colors. The upper left-hand corner contains a picture of the company's building in Boston.

HAZARD CALENDAR.—The Hazard Manufacturing Company, Wilkesbarre, Pa., has issued a calendar for 1909, each sheet of which contains illustrations of some of the company's products. Wire cables, rubber-covered wires, telephone and telegraph wires, magnet wires, etc., are thus shown. The monthly calendars are printed in large and legible figures.

GEORGE W. JACKSON, INC., Chicago, Ill., is sending out a January calendar, on which appears a cut made from a photograph showing the details of the steel sheeting construction on the Kinzie Street Bridge, Chicago, Ill. This firm does a general engineering, contracting and manufacturing business and makes a specialty of steel bridges, structural steel and machinery for subways, tunnels and heavy foundations.

Trade Publications.

SNAP SWITCHES.—The General Electric Company has recently issued a booklet, No. 3701, in which are listed and illustrated snap switches, both indicating and non-indicating, flush switches of the rotary and push-button type, pendant and ceiling switches.

"UNIVERSAL" ELECTRIC IRON.—The Pelouze Electric Heater Company, 403 Ohio Street, Chicago, Ill., in a new circular describes and illustrates its "Universal" electric iron. Several advantages are claimed for this device, among which is its availability as an electric stove or heating disk.

CHAIN BLOCKS.—Yale & Towne Manufacturing Company has just issued its new chain block catalog, describing not only its line of chain hoists, both hand and electric, but trolleys, trolley blocks, etc. This is an even more expensive and carefully considered production than any published by the concern relative to this specialty.

ELECTRIC SPECIALTIES.—The 1909 catalog of the Machen & Mayer Electrical Manufacturing Company, Philadelphia, Pa., contains illustrations, descriptions and prices relating to flush switches, flush receptacles, pendant switches, wall cases, conduit boxes and panel boards. The company has also isued a bulletin devoted exclusively to panel boards.

AMERICAN SCHOOL OF CORRESPONDENCE, Chicago, Ill., is sending out circular matter describing its new "Cyclopedia of Applied Electricity." This cyclopedia contains much authoritative information on the latest electrical developments. It is compiled from the regular text-books used in the correspondence courses of the school. There are six large volumes.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing a bulletin descriptive of the Hartman type auto transformer and circuit breaker for use in conjunction with polyphase induction motors. These starters are primarily designed for use in mills and factories, and by means of overload, underload and low voltage coils secure the maximum degree of protection. Copies of this bulletin will be sent upon request.

MINIATURE LAMPS.—Bulletin No. 8 issued by the engineering department of the National Electric Lamp Association, Cleveland, Ohio, deals entirely with miniature incandescent lamps of the carbon filament type. It contains a complete list of the regular types of miniature and candelabra carbon lamps for decorative purposes, battery inspection, automobile headlights, telephone and various special service. These lamps are all shown and are described in detail, inclusive, of such interesting and less usual types as the little unbased festoon lamp and the long-stemmed battery inspection type. The special styles include dental, surgical, etc.

BIRD'S-EYE VIEW OF BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company, Birmingham, Ala., has issued a folder containing a bird's-eye view of the Birmingham district. The covers are brown and gray. There is a general view of the city at the top, and typical scenes are shown of the extraction of coal, limestone and iron, at the bottom, grouped artistically and surmounted by the cupolas of belching furnaces, as indicative of the natural resources of Birmingham. The descriptive matter is illustrated by half-tones of the principal points of interest in the city and of scenes along the company's trolley lines. The bird's-eye view of the city is 38 in. long by 14 in. wide.

Business Notes.

FEDERAL SIGN SYSTEM, Chicago, Ill., has opened up a new rental office at 119 West Third Street, Louisville, Ky. Representatives of the firm state that a large amount of new business has already been secured through the efforts of the new office.

LUNKENHEIMER VALVES.—Our attention has been called to the fact that the valves furnished by the Lunkenheimer Company, of Cincinnati, Ohio, for the Isthmian Canal Commission are guaranteed for 200-lb. working pressure and not for 20-lb., as was stated in an item in this column in the issue of Dec. 5.

COMMERCIAL TESTING & ENGINEERING COMPANY, consulting fuel engineers and chemists, has opened offices and laboratories in the Old Colony Building, Chicago, Ill. The company announces that it is thoroughly prepared to make mechanical and chemical tests in boiler room economies. The officers of the company are Edward H. Taylor, president; Harry W. Weeks, vice-president; W. D. Stuckenberg, treasurer; B. J. Maynes, secretary.

THE F. BISSELL COMPANY, of Toledo, Ohio, manufacturer of electrical supplies, has leased the property at 402 and 406 Erie Street for its factory. The new factory will be used for the production of the various articles that have been manufactured by the company at the old location. Walter L. Bissell has been made treasurer of the company to fill the place made vacant by the resignation of L. N. Bardol, who is now with the Toledo-Massillon Bridge Company.

OLIVETTI INSTRUMENTS.—The famous European firm of C. Olivetti & Company, of 4 Broggi, Milan, Italy, is desirous of placing an American agency with some reliable person or concern. It may not be generally known that the electrical measuring instruments of this concern are in wide use all over Europe and enjoy a high reputation for central station, power house, laboratory use, etc. Mr. C. Olivetti, the president of the company, is at present in this country on a visit.

THE PACIFIC ELECTRIC HEATING COMPANY, Ontario, Cal., has opened a branch factory at 63 West Washington Street, Chicago, Ill. During the past year this company has secured such a favorable business in the Middle West and the East that it found it absolutely necessary to open up a factory in Chicago for the manufacture of its well-known "Hot Points" flatiron. The main floor of the factory is 22 ft. x 100 ft. in size. The front portion of the building is utilized for office, storeroom and shipping room purposes, and the balance of the building is occupied by the machine shop and assembling room. The new factory is very conveniently arranged for the quick assembling of the various parts which go to make up the "Hot Points" iron. The main castings of the iron are sent to Chicago from the company's Ontario (Cal.) factory, where a large foundry is maintained for the casting of the bottom part of the iron. The resistance wires, brass core castings, handle, screws and other parts used in the assembling of the iron are purchased in the Eastern market. The assembling room of the new factory is provided with all the necessary and most modern machinery, which will allow the work of assembling the parts to be done very quickly. Along one side of the assembling room is located a small track, on which cars, carrying the parts of the irons to be assembled, are operated. By the use of these cars the main castings of the iron are placed on one of the cars at one end of the assembling room and shoved along from one workbench to another until the process of assembling is completed. When the car arrives at the end of the room opposite from the starting point the irons are completed. They are then carefully tested, and the meter readings are accurately stamped on each iron. The platform of the car is then placed on a portable truck and taken to the shipping room. By this method of assembling the parts, the iron is handled but once after the main casting is brought into the factory. The company announces that it has made several notable improvements in its irons and expects to demonstrate these improvements for the first time at the Chicago Electrical Show, which will be held at the Coliseum, Chicago, Ill., from Jan. 16 to 30, 1909. Mr. Henry F. Holland is the Chicago manager of the company.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED DEC. 29, 1908.

[Conducted by William F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

907,712. PROTECTED HIGH-POTENTIAL RAIL; A. H. Armstrong, Schenectady, N. Y. App. filed July 21, 1906. A third rail, a return conductor, a protective covering for the rail and an electric connection, including a resistance between the covering and the return conductor.

907,714. ELECTROMAGNETIC RELAY; G. Babcock, Rochester, N. Y. App. filed May 31, 1906. An electric relay with a movable core, a bulb containing an electrical conducting liquid controlled by the core and spring mechanism adjusting the position of the bulb, a winding disposed about the core which is adjustable with relation to the core.

907,715. DRIVING-WHEEL FOR ELECTRICALLY-PROPELLED VEHICLES; D. Balachowsky, Paris, and P. Caire, Levallois-Paris, France. App. filed May 8, 1907. The motor is embodied in the wall structure and certain of the elements are used as brake rings.

907,717. CHOKE-COIL FOR MOVING-PICTURE MACHINES; H. J. Beck, Phillipsburg, Pa. App. filed July 30, 1908. A U-shaped core with a coil-supporting plate mounted upon one of the side pieces of the core and a resistance coil mounted upon said supporting plate.

907,726. TROLLEY-WHEEL; C. M. Bradfield, Grand Rapids, Mich. App. filed March 28, 1908. A trolley wheel with railway bearings. Details.

907,738. POLE-PIECE FOR DYNAMO-ELECTRIC MACHINES; A. Churchward, Chicago, Ill. App. filed Aug. 23, 1901. A laminated pole piece having the metal portion of the laminæ cut away.

907,740. SWITCH-BOX; A. G. Clark, Schenectady, N. Y. App. filed April 18, 1908. For use with track switches of a block system, in which a casing with two shafts journaled in the casing is provided. A crank on one shaft is connected to the track switch and a second crank on the shaft is connected with a link and a second shaft, on which latter shaft the switch contacts are mounted.

907,751. TESTING SYSTEM FOR TELEPHONE LINES; W. W. Dean, Chicago, Ill. App. filed June 29, 1903. Relates to improvement on a prior patent. Isolates the common portion of the testing circuit from the cord circuits, so that if the latter are short-circuited the testing relay is not operated.

907,752. ELECTRIC CONTROLLER; W. S. Deeds, Pittsburg, Pa. App. filed Feb. 18, 1908. Details in the construction of a drum controller for a wireless armature induction motor.

907,763. CONTROLLER-CHECKING DEVICE FOR STREET RAILWAY CARS; Nathan Fallek, Denver, Col. App. filed Sept. 9, 1907. A controller check electrically operated, comprising an operatively arranged controller, crank with a ratchet wheel movable with the crank, a locking pawl and an electromagnet for actuating the pawl.

907,782. INCANDESCENT ELECTRIC LAMP SOCKET; G. W. Goodbridge, Bridgeport, Conn. App. filed July 31, 1907. The socket has a cap with a number of projections on the flange which receive corresponding tongues on the shell.

907,788. INSULATOR CLIP; A. R. Hall, Leonardsville, N. Y. App. filed Oct. 21, 1908. The clip comprises a U-shaped member or a stirrup of wire, which engages the insulator and secures the line wire to it.

907,831. RESISTANCE-ADJUSTING DEVICE; H. P. MacLagan, Chicago, Ill. App. filed April 24, 1907. Details in a variable resistance for electric motors.

907,834. INSULATOR; G. B. Marshall, Shannon, Tex. App. filed Oct. 9, 1908. A spike insulator adapted to be driven between the bricks in a wall, one side of the spike forming the clip to hold the button or washer.

907,852. BATTERY CONNECTOR; H. W. Munyan, Worcester, Mass. App. filed Feb. 21, 1907. The connector consists of a continuous conductor with resilient oil terminals in one integral piece with the conductor which forms compressible springs at the ends thereof.

907,866. LIGHTNING ARRESTER; Albert Oleson, Toledo, Ohio. App. filed Aug. 1, 1906. A pair of fuse wires connecting separated terminals of the circuit and a mass of high conductivity is connected with the ground, and is located between the terminals. It carries away the current when the fuse wires blow out.

907,872. OIL ON THERMAL CUTOUT; C. N. Pratt, Rochester, N. Y. App. filed June 6, 1907. Extinguishes the arc caused by the flashing of a fuse by an oil batù. A conduit connects with the interior of the receptacle containing the oil, the outer end of the conduit being sealed by liquid.

907,884. MOTOR COMPRESSOR; W. J. Richards, Milwaukee, Wis. App. filed Nov. 4, 1907. For air-brake systems on electric railways containing a crank case, a motor frame and a compression compartment frame and a removable cover on the under side of the crank case forming an oil well.

907,891. COMMUTATING DYNAMO-ELECTRIC MACHINE; K. Sulzberger, Charlottenburg, Germany. App. filed Jan. 16, 1906. A field magnet, an armature provided with a commutator and a commutating pole which is slotted, the slot being dissymmetrical with respect to the axial plane through the middle of the pole.

907,899. TROLLEY GUARD AND REPLACER; J. J. Schultz and W. C. Taggart, Richmond, Ind. App. filed May 25, 1908. Details in a trolley replacer.

907,911. APPLIANCE FOR CONDUIT WIRING; J. S. Stewart, New York, N. Y. App. filed Nov. 23, 1907. Lamp receptacle for an outlet box, the box having an open side and a pair of lugs projecting inwardly, with an independent retaining device engaging the lugs and bearing against the body to retain it in position against the bottom of the box.

907,931. APPARATUS FOR REGULATING THE VOLTAGE OF AN ELECTRIC CURRENT; Wynant James Williams, Albany, N. Y. App. filed March 12, 1908. Automatically regulates the voltage in proportion to the load by using a core of laminated soft iron surrounded by a coil in series with the load circuit.

907,960. TELEPHONE ATTACHMENT; G. J. Boelen, The Hague, Netherlands. App. filed June 3, 1908. The telephone circuits start a talking machine, which co-operates with the telephone. Details.

907,970. SEPARATOR FOR STORAGE BATTERIES; R. N. Chamberlain, Depew, N. Y. App. filed May 11, 1905. A separator for storage battery plates in which a flexible holder of non-conducting material retains the sections in place.

907,975. TELEPHONE TRANSMITTER; W. W. Dean, Elyria, Ohio. App. filed Dec. 4, 1902. Relates to an improvement in a party line common battery telephone system by placing in the bell branches a suitable electrolytic cell which may become quickly charged. The cells stop the flow of steady current, but permit the passage of ringing current.

907,984. TROLLEY; Joseph Franklin, Philadelphia, Pa. App. filed May 1, 1907. A trolley in which the wheel is supported by two telescoping arms, the car being adapted to run in opposite directions without reversing the trolley.

907,985. PUSH-BUTTON CONTROLLED PLUNGER-ELEVATOR SYSTEM; Floyd C. Furlow, Montclair, N. J. App. filed April 25, 1906. A brake apparatus is associated directly with the plunger of the elevator and is operated with a hydraulic motor independently of the operation of the change valve apparatus.

907,986. COMBINED ELECTRIC-BRAKE AND PUSH-BUTTON PLUNGER-ELEVATOR SYSTEM; Floyd C. Furlow, Montclair, N. J. App. filed Jan. 8, 1907. An electric brake apparatus for the plunger positively holds the car stationary at a desired landing.

908,031. TROLLEY SWITCH; A. Palmros, Fairmont, W. Va. App. filed Jan. 12, 1901. A movable tongue switch plate directs the trolley from one conductor to another. Details.

908,063. WHISTLE; Henry W. Aylward, New York, N. Y. App. filed Jan. 22, 1908. An electrically operated whistle for warships. The whistle is blown by steam and the valve is controlled electrically.

908,068. TROLLEY HARP; Thomas F. Brennan and Thomas J. Mullen, New York, N. Y. App. filed June 4, 1908. Details in the construction of the oiler for the axle of the trolley.

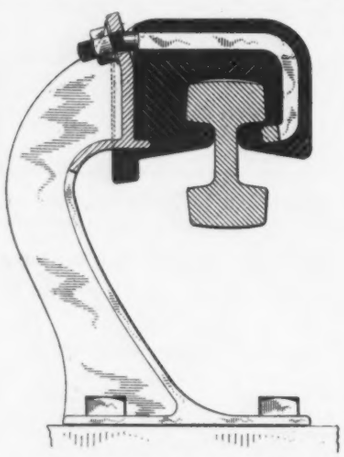
908,089. INSULATOR; J. C. Gibson, Owensboro, Ky. App. filed May 9, 1908. Insulator made of two sections, one with a wire receiving groove and the other screwing down upon the first section.

908,097. MAGNETO ALTERNATING-CURRENT GENERATOR; A. Herz, Vienna, Austria-Hungary. App. filed Feb. 13, 1905. Puts the primary circuit in short circuit and breaks it at each half period. A closed circuit around the arms of the magnet receives an induced current to prevent demagnetization of the magnet.

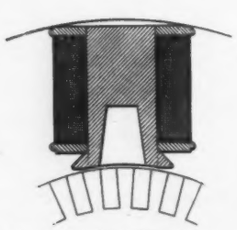
908,098. WINDING FOR ROTATING FIELDS; H. Hertz, Chicago, Ill. App. filed Jan. 2, 1906. Special winding for high-speed generators with heavy conductors in slots in the armature core. The winding starts at the outer one of the connectors and proceeds inward, then outward.

908,117. LIGHT REGULATOR FOR ELECTRIC LAMPS; Thomas E. Murray, New York, N. Y. App. filed Feb. 11, 1907. The regulator contains a liquid insulator, with a rotary shaft, a contact plate thereon and buckets which project the insulator upon the bearing surface of the contact.

908,118. LOCKING DEVICE FOR FUSE PLUGS; Thomas E. Murray, New York, N. Y. App. filed June 9, 1908. A fuse-plug body having a cylindrical threaded portion, a flange, and above said flange a flaring cup-shaped portion with slots in its wall.



908,136—Third-Rail Insulator.



907,738—Pole Piece for Dynamo-electric Machines.

908,123. OIL SWITCH; J. B. Opsahl, Chicago, Ill. App. filed Sept. 26, 1907. The oil is subjected to pressure and acts directly upon the movable contact to operate it. The oil is circulated so as to give a clean supply.

908,126. ART OR METHOD OF TREATING AND UTILIZING CHLORIN GAS; E. C. Paramore, Philadelphia, Pa. App. filed Feb. 5, 1907. Removes the odor from chlorin gas by washing it with acid, cooling it, heating it highly, then electrifying it, and finally liquefying the gas.

908,130. METHOD OF PRODUCING SILICON; H. N. Potter, New Rochelle, N. Y. App. filed May 22, 1905. The process of eliminating silicon carbid from silicon, consisting in reacting upon the said carbid by means of silicon dioxid and fluid silicon.

908,135. ELECTRIC METER; W. H. Pratt and C. E. Holmes, Lynn, Mass. App. filed June 5, 1905. Integrating meters of a commutating motor type. The actuating coil has its axis perpendicular to the shaft and a circular permanent magnet damps the movement of the shaft.

908,136. THIRD-RAIL INSULATOR; L. M. Randolph, Newark, N. J. App. filed May 2, 1907. Improves the insulation by having the overlapping flanges so arranged that one part overlaps the other to cover the joint between them.

908,166. ROSETTE; J. S. Stewart, New York, N. Y. App. filed Dec. 23, 1907. The terminal supporting member has gripping jaws and a retaining device separate from the cover of the box holds the member in place.

908,167. ELECTRICAL DISTRIBUTION SYSTEM; P. H. Thomas, Montclair, N. J. App. filed Nov. 8, 1904. A mercury vapor device is placed in series across the circuit, with a resistance in series therewith and the circuit containing the translating device is arranged in shunt to the mercury vapor device. This maintains a uniform potential for the translating devices.

908,174. COMBINED FUSE-PLUG AND CIRCUIT-CLOSER; F. E. Vindemore, Fairview, N. J. App. filed March 7, 1908. Circuit-closer for high-potential circuits, including a fuse detachably secured to a base, a circuit-closer and an electromagnet carried by the detachable member for operating the circuit-closer.

908,180. THIRD RAIL; W. J. Wilgus, Yonkers, and Frank Julian Sprague, New York, N. Y. App. filed May 27, 1905. An inverted third rail, insulated and provided with a protective cover, the latter being of bendable insulating material supported by the rail and protecting it between the points of suspension. The holding blocks for the rail are of non-charring, moisture-proof material.

908,189. RAILWAY SIGNAL; H. M. Abernethy, Cleveland, Ohio. App. filed March 24, 1906. An electrically operated block-signal system in which the semaphore blade is operated by a sheave and chain driven by an electric motor.

908,213. TELEPHONE SYSTEM; W. W. Dean, Chicago, Ill. App. filed Dec. 4, 1902. Relates to an improvement in a party line common battery telephone system by placing in the bell branches a suitable electrolytic cell which may become quickly charged. The cells stop the flow of steady current, but permit the passage of ringing current.

908,238. AUTOMATIC ELECTRIC GAS-RANGE LIGHTER; M. L. Ganser, Norristown, Pa. App. filed Aug. 12, 1907. For lighting gas ranges. Details.

908,251. ELECTRIC CONTROLLING MEANS; F. G. Haldy, Stamford, Conn. App. filed Aug. 19, 1908. For controlling the lowering speed of hoists, by means of a supplemental resistance, with means for placing the armature and field in series and excluding the resistance, which means are also operative to reverse the armature circuit and place it in parallel with the field winding and the supplemental resistance, and the latter in series with the field.

908,297. APPARATUS FOR IONIZING PETROLEUM AND ITS DISTILLATES; D. Martini, London, Eng. App. filed May 29, 1908. Changes petroleum into an explosive mixture for use in gas engines, by changing the petroleum into a spray, mixing it with the gas and ionizing and expanding the mixture.

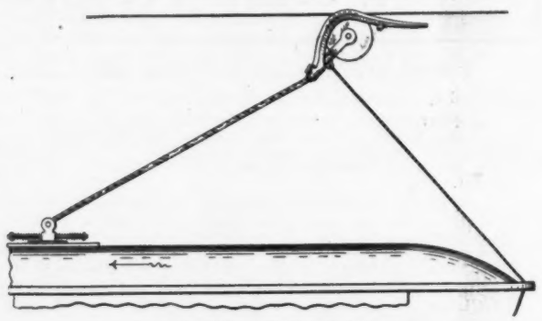
908,300. COMBINED GAGE AND SIGNAL DEVICE; M. G. Melvin, Scranton, Pa. App. filed Dec. 3, 1907. A "Bourdon" tube gage, which closes an electric switch to ring a bell when the pressure rises or falls beyond a predetermined amount.

908,307. SWITCH; L. H. Moulthrop, Bridgeport, Conn. App. filed Sept. 12, 1908. A push-button switch in which a rock lever is actuated by the buttons. A snap make-and-break is provided by a special construction of the means for operating the contact piece.

908,328. ELECTRIC SWITCH; J. G. Peterson, Hartford, Conn. App. filed Dec. 17, 1907. A rotary snap switch in which the stop ratchet can be simply dropped into place and held without fastening means of its own. Details.

908,357. METHOD OF PRODUCING SILICON CARBID; F. J. Tone, Niagara Falls, N. Y. App. filed July 11, 1908. Embeds a resistance in a charge of silicious and carbonaceous material, initially heats the charge by combustion, and then passes current through the resistance to produce silicon carbid.

908,378. METHOD AND MEANS OF HERMETICALLY SEALING A CONDUCTOR IN GLASS; C. O. Bastian and George Calvert, London, Eng. App. filed Oct. 19, 1906. The glass is provided with a passage and the conductor with means which on cooling hermetically seals the passage at one point, while upon heating it closes the passage at another point.



907,899—Trolley Guard and Replacer.

908,379. SWITCHING DEVICE FOR ALL RAILWAYS; William F. Bath, Murray, Idaho. App. filed Sept. 19, 1905. A special mechanism locks the switch in the desired position and gives a signal to show that the switch has been operated.

908,386. SAFETY PORTABLE MANUAL GENERATOR FOR IGNITING MINERS' SAFETY LAMPS; J. C. Bowie and J. H. Phelps, Cardiff, Eng. App. filed Oct. 11, 1907. Provides a special cup into which the miner's lamp, which is lighted by the generator, can be fitted, thus avoiding danger of explosion.

908,389. ELECTRICAL CONNECTION; W. H. Briggs, Richmond Hill, N. Y. App. filed May 9, 1908. A battery connection with a terminal clip having a spring loop uniting wings which engage a binding post. Details.

908,397. CONTROLLER FOR ELECTRIC CIRCUITS; M. W. Day, Schenectady, N. Y. App. filed June 27, 1907. For controlling the field of a generator, by means of a fixed resistance in series with the field and a variable resistance arranged to be connected in shunt either to the field or to said fixed resistance.

908,407. ELECTRIC FURNACE; P. L. T. Héroult, La Praz, France. App. filed Oct. 3, 1907. A stuffing box for the electrode of an electric furnace provided with loose granular conducting material.

908,408. SYSTEM OF MOTOR CONTROL; G. H. Hill, Schenectady, N. Y. App. filed Aug. 23, 1907. A train controlled system in which variations in voltage on the line are prevented from influencing the current in the control circuits to such an extent as to interfere with the operation of the contactors by utilizing a resistance with means for cutting the resistance in and out as the voltage exceeds or falls short of a certain amount.

908,427. ELECTRIC METER; G. E. Stevens, Lynn, Mass. App. filed June 8, 1905. An integrating wattmeter provided with a friction compensating coil with means for adjusting it in two different planes.

908,428. ELECTRICALLY CONTROLLED SECONDARY CLOCK; S. P. Thrasher, Hartford, Conn. App. filed March 20, 1908. An electrical mechanism is controlled by a master clock, the mechanism operating gravity devices for driving the clock.

908,432. IGNITING DEVICE FOR MINERS' SAFETY LAMPS; F. A. Wicke, Barmen, and Rudolf Gartenmeister, Elberfeld, Germany. App. filed July 8, 1908. A platinum wire becomes incandescent and ignites a primer which, in turn, ignites the wick of a miner's lamp, thus avoiding explosion.